The

Tropical Agriculturist

June 1929.

EDITORIAL.

CEYLON TERMITES.

THE serious damage for which termites are responsible in Ceylon entitles them to a very prominent position among the insect pests of the Island. They are familiar as pests of buildings in most parts of Ceylon and they have acquired considerable notoriety on account of their wholesale destruction of tea bushes in certain localities. Their injurious activities extend to other crops of importance, particularly coconuts, cacao and coffee, and to a large number of useful and ornamental trees.

The termites which are pests of buildings and their furnishings belong to two distinct groups. Most of the domestic species invade buildings from soil nests with which constant communication is maintained and their control depends upon the complete insulation of the superstructure from the foundations and from the soil by means of an impenetrable termite barrier. Termites of the second group nest in building woodwork without contact with the soil; they are responsible for extensive damage to roof-timbers. This type of injury is frequently, though incorrectly, termed "dry-rot" in Ceylon. The invasion of building woodwork by the termites of the second group can be prevented by the employment of timber which has been impregnated with a suitable preservative prior to installation.

Although the financial loss resulting from the damage caused to buildings by termites is far greater than is generally recognised it is insignificant when compared with the loss due to the injury caused by these insects to living plants of economic importance. The termites which destroy living plants are, with few exceptions, species which nest above the soil. The most notable exceptions are species of *Coptotermes* which are subterranean in habit and invade their hosts through their root systems. Instances of this type of injury to coconut palms have been observed recently, and it is possible that many previously unexplained casualties among palms have been due to the agency of termites of this genus. Owing to the insidious nature of their attack, the death of the palms or their collapse in high winds is often the first observed indication of infestation. The problem of controlling species of *Coptotermes* is complicated by the fact that their main nests are extremely difficult to locate and that their subterranean workings are of an extensive nature. Other species of ground-nesting termites are responsible for damage to seed nuts in coconut nurseries. Species of *Calotermes*, again, construct their nests in the heartwood of their host plants. A considerable acreage of tea in Ceylon is attacked by three species of this genus and there can be little doubt that the attacked area is undergoing a steady and progressive extension. The injury caused to cacao and coffee is limited, but, where it occurs, it is serious.

The entry of these termites into woody plants is effected by the winged stages of the insects through wounds and snags. Originally, the Ceylon species of *Calotermes* must have been confined to jungle trees and their opportunities of becoming established in these host plants were probably limited to occasional snags naturally produced by the fracture of branches by wind or other agencies. The dieback of branches which follows the pruning of tea bushes, with its resultant decay of the heavier wood, affords ideal conditions and ample scope for entrance to, and development in, tea bushes by *Calotermes*, and the control of these pests should primarily be directed towards depriving them of their sole means of gaining admittance to the heartwood of the bushes.

In the meantime, owing to the generous co-operation of the Bureau of Entomology of the United States Department of Agriculture, a simple and effective method of destroying *Calotermes* colonies in living plants is available. The method consists in introducing into their galleries a small quantity of Paris Green powder. The system of control has been given a thorough trial in Ceylon and it has been found that entire termite colonies of tea bushes can be destroyed within a period of three months without injury to the bushes or to the manufactured tea.

Figure 1.

ORIGINAL ARTICLES.

A ROOT GROWTH EXPERIMENT WITH HEVEA.

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GOVINNA ESTATE.

THE object of the experiment was to test the amount of root growth induced in mature rubber by the application of different manures singly and in combination, the amounts of manure applied being such as would represent an expenditure of Rs. 50-00 per acre at prices ruling in January, 1928.

The amount of manure which would be applied to an area of soil equal to the area of a chatty opening was thoroughly mixed with the necessary earth and filled into a standard size of chatty. As in estate practice manure is usually applied to only about half the area of a field, the amount of manure used should be twice as much as is worked out by the direct ratio.

The soil used was a typical rubber estate soil (so far as one can approximate to an average). It was sieved through a $\frac{1}{4}$-inch mesh and thoroughly mixed; equal amounts were placed in each chatty and subjected to equal pressure. As, in an experiment of this nature, equal physical conditions are important, the question of equal pressure was met by resting a log of wood weighing about 40 lbs. on the earth in each chatty. This appeared to give the right compression. Each treatment was repeated ten times and a set of ten controls was treated under similar conditions for every four sets manured. There were thus forty controls. The chatties were buried on level ground in mature rubber. The lips of the chatties were placed at a uniform depth of 2-3 inches below the surface. The bottom of each chattty had a small hole knocked in it to prevent water-logging and theft. Some 230 chatties were specially made, and, as the illustration (fig. 1) shows, they were wide-mouthed and flat. Their average diameter was $9\frac{3}{8}$ inches, and the area of the mouth was 69·1 sq. inches or roughly half a square foot. Each chatty had its serial number tarred on it and its position was marked by a similarly numbered country till. One chatty of each series was dug up in June. Results were judged by the dry weight of the roots growing in each chatty (tables 2 and 3 and fig. 2).

In order to get some idea of the rates of availability of the manures used and of their duration it was decided to apply them in equivalent amounts to plots of 1/2000th-acre on a mown grass lawn, and to observe the colour and growth of the grass. Table 1 shows the manures used and the amounts given to the pots and the lawn plots. An experiment of this nature must be considered tentative. For that reason it is felt that the publication of a

statistical examination of the figures may be misleading. For example, the results obtained from nitrate of soda, excellent in the first series and below normal in the rest, probably indicate an unequal admixture of the manure. Again, though the chatties in each series were systematically "staggered" so that no two of each were closely placed, it is possible that any two or three of one series, though far apart, may have encountered root or local soil conditions differing from those encountered by other numbers of the series. Nor is it pretended that what roots "like," to adopt an anthropomorphic simile, is that which will ultimately so affect the metabolism and growth of the tree as to give the highest yield. But one can at least claim for such an experiment that without enhanced root growth other results are unlikely to follow.

It will be noticed (table 1) that none of the treatments consisted of phosphoric or potash or of combinations of these *without nitrogen*. The reason for this was that, both in the writer's experience and from the results of all credible manuring experiments, nitrogen must be considered the first limiting factor in Ceylon rubber soils, and it follows that, until that need is first satisfied, the addition of phosphoric and potash is useless or even possibly detrimental. It was therefore not wished to make the experiment more unwieldy for a purely academic purpose. It will be seen from table 3 that the highest average results were got with calcium cyanamide; the lowest (apart from those of nitrate of soda, which obviously were due to an error in the experiment) were got from ground-nut cake.

The total nitrogen applied as cyanamide was on an 18½ % basis, that is, 129·5 lb. per acre. The nitrogen content of the ground-nut cake was 50·4 lb. per acre. On the other hand, the 800 lb. of bonemeal supplied 24 lb. of nitrogen and 176 lb. of phosphoric. Where, in No. 16, the nitrogen content of the bones was raised to 76 by the addition of cyanamide and the phosphoric correspondingly reduced to 88 lb., a noticeable increase was effected. The addition of muriate of potash does not appear to have had a significant effect.

The acidity or alkalinity of the mixtures has been noted in the margin of table 3. It will be seen that the best results were got with alkaline or neutral mixtures. Yet, in estate practice on Govinna, very remarkable effects on growth and foliage have been got with acid mixtures such as sulphate of ammonia or ammonia with con-super (a 90 N 96 P_2O_5 mixture). It is conceivable that field conditions, for mechanical and physical reasons, would differ from those within the confines of a chatty. The pH of representative chatties was tested with a B.D.H. Soil Indicator when they were dug up. Little or no difference was found in any of them; they ranged between 5:5 and 6. Only one of the cyanamide chatties gave 7. The figures were in agreement with field tests.

A point deserving of consideration is the relative cost of applying an organic *versus* an inorganic. It is essential that organic mixtures be properly incorporated, whereas inorganics might conceivably be applied superficially. In fact, in the writer's experience, excellent results have been so obtained. The cost of envelope forking being about Rs. 7-00 per acre, this would allow roughly of the superficial application of a further 20 lb. of nitrogen in a soluble form or of treating a larger acreage.

Although the soil was sieved only immediately prior to laying down the experiment and all coarse organic matter was removed, the process of sieving would increase nitrification and so tend to mask results, favouring the controls and those with less nitrogen.

The lawn plots were laid down on March 19th. Owing to dry weather the inorganics burnt the grass but the plots soon recovered. It is significant of the rate of nitrification that No. 6 (fish) was noticeably greener by the 26th, that is, after seven days. On April 3rd the greenest plots were those with ammonium sulphate, with or without minerals. By April 26th all plots were noticeably darker except bonemeal which at no time produced any visible effect. This is hardly surprising as the amount of nitrogen in 800 lb. of bones is only 24 lb. On May 26th all plots were mown. Nos. 2 and 11 were the best and the tall dense grass when cut left these plots brown and almost bare. There was little to choose between the remaining mineral plots which were better than the fish and animal meal plots. The plot treated with ground-nut cake was never more than barely noticeable. This is in interesting agreement with its chatty results. On July 8th faint traces only of the effects of Nos. 1, 9, 18, and 19 could be noticed and these had entirely disappeared a few days later.

Lawn experiments on these lines have been laid down yearly since 1924 and in no case has it been found that the effects either of organics or inorganics lasted more than three months, and the effect of the inorganics has lasted as long as, and sometimes longer than, that of the organics. The curve of nitrification rises so steeply between 75°F and 85°F, the usual temperature of optimum rubber soils, that this is to be expected.

Various well-known mixtures gave similar results. Some of them, containing inadequate nitrogen, gave very little apparent reaction. A measure of the effects might almost have been made by counting the numbers of small grasshoppers which were always to be found in numbers in the best plots and hardly at all in the worst, or in the control strips between the plots.

My thanks are due to Mr. W. R. Thomson and Mr. A. R. Westrop for supplying the sample manures and to these gentlemen and Mr. Minor for assisting in laying down the experiments and in performing the subsequent work.

CONCLUSIONS.

1. While it would be unsafe to generalise from a limited experiment, it would appear that inorganics can produce as much root growth as, or more than, an equal value of organics.

2. That, if the cost of forking in the organics is considered, the effect might be even more in favour of inorganics.

3. That alkaline or neutral fertilisers appear best suited to these soils.

4. That the effect of organics does not appear to last longer than that of inorganics at these temperatures. It is, therefore, not worth while paying from $2\frac{1}{2}$ to $3\frac{1}{2}$ times more for the unit of nitrogen in order to obtain a slow rate of availability which, in fact, is not got.

Table I.

Treatments laid down in pots and on lawn 18-3-28.

		Rs. 50/- worth. lb.	Double. lb.	Lawn. ozs.	Pots ozs. per 10 pots.
No. 1.	Calcium cyanamide	700	1400	11·2	2·46
2.	Sulphate of ammonia	590	1180	9·4	2·06
3.	Nitrate of soda	605	1210	9·6	2·11
4.	Ground-nut cake	720	1440	11·6	2·52
5.	Control				
6.	Fish guano	640	1280	10·2	2·25
7.	Animal meal	535	1070	8·6	1·87
8.	Bone meal	800	1600	12·8	2·80
9.	Sulphate of ammonia	295	590	4·6	1·03
	Conc. superphos.	315	630	5·	1·10
10.	Control				
11.	Sulphate of ammonia	295	590	4·6	1·03
	Ephos	590	1180	9·4	2·06
12.	Sulphate of ammonia	295	590	4·6	1·03
	Conc. superphos	225	450	3·6	·78
	Muriate of potash	100	200	1·6	·33
13.	Calcium cyanamide	350	700	5·6	1·22
14.	Cyanamide	350	700	5·6	1·22
	Ephos	590	1180	9·4	2·06
15.	Control				
16.	Cyanamide	350	700	5·6	1·22
	Bone meal	400	800	6·4	1·40
17.	Cyanamide	350	700	5·6	1·22
	Bone meal	285	570	4·5	1·00
	Muriate of potash	100	200	1·6	·33
18.	Cyanamide	350	700	5·6	1·22
	Ephos	420	840	6·6	1·47
	Muriate of potash	100	200	1·6	·33
19.	Cyanamide	200	400	3·2	·70
	Bone meal	200	400	3·2	·70
	Ground-nut cake	335	670	5·4	1·17
20.	Control				

E. G. Calcium cyanamide 11·2 ozs.

Table II.

Dry weight of roots in ozs. per 20 lb. of earth.

Nos.	A	B	C	D	E	F	G	H	J	K
1.	·760	·579	·539	·948	·871	1·545	·491	·575	·927	1·781
2.	·397	·412	·234	·433	·349	·492	·577	·425	·454	1·072
3.	1·302	·150	·191	·286	·177	·506	·169	·214	·124	·718
4.	·417	·483	·443	·298	·397	·654	·552	·417	·361	·278
5.	·083	·144	·243	·176	·058	·433	·517	·207	·478	·520
6.	·621	·439	·316	·418	·151	·282	1·228	·920	·885	·600
7.	·234	·430	·199	·709	·580	·928	1·882	·334	·825	·365
8.	·203	·365	·713	·931	·587	·770	·816	·960	·626	·541
9.	·074	·203	·571	·414	·893	·745	·389	·554	·493	·578
10.	·180	·326	·245	·291	·261	·405	·472	·589	·295	·298
11.	·237	·496	·451	·529	1·014	1·078	·553	·687	·312	1·025
12.	·209	·228	·479	·451	·364	·246	·482	·376	1·240	·338
13.	·375	·832	·883	·437	·465	·357	·612	·852	1·520	·388
14.	·118	·901	·564	·483	·814	·851	1·394	·506	1·913	·554
15.	·052	·270	·064	·526	·528	·361	·730	·380	·916	·357
16.	·832	·772	·571	·418	·833	1·392	1·429	·470	1·345	·954
17.	·436	·874	1·088	·366	·575	1·217	·570	·905	1·058	1·097
18.	·261	·837	·642	·438	1·248	·747	1·017	·576	·648	·753
19.	·393	·703	·418	·481	·632	·660	1·056	·849	·625	·746
20.	·102	·149	·225	·205	·154	·116	·552	·467	·698	taken up in series G.
Control	·104	·222	·199	·299	·242	·326	·612		·473	

Series A dug up 7th and 9th June 1928
,, B & C dug up 17th and 19th August 1928
,, D, E, F, G dug up 12th October 1928
,, H, J, K dug up 17th December 1928.

Table III.

Average weights of each series.

Nos.	A	B & C	D.E.F.G	B.C.D.E. F.G	H.J.K	B.C.D.E.F G.H.J.K	D.E.F.G H.J.K.	pH +alkaline —acid N. neutral
1.	·760	·559	·964	·828	1·094	·917	1·020	+
2.	·397	·323	·463	·416	·657	·494	·543	—
3.	1·302	·171	·285	·247	·353	·282	·314	N
4.	·417	·463	·475	·471	·352	·431	·422	N
5.	·083	·194	·296	·262	·402	·308	·341	
6.	·621	·378	·520	·472	·802	·582	·641	N
7.	·234	·315	1·025	·788	·508	·695	·803	N
8.	·203	·539	·776	·697	·709	·701	·747	N
9.	·074	·387	·520	·536	·542	·538	·581	—
10.	·180	·286	·357	·333	·394	·354	·373	
11.	·237	·474	·794	·687	·675	·683	·743	—
12.	·209	·354	·386	·375	·652	·467	·500	—
13.	·375	·858	·468	·599	·920	·705	·662	+
14.	·118	·733	·885	·835	·964	·887	·931	+
15.	·052	·167	·536	·413	·551	·459	·543	
16.	·832	·672	1·018	·903	·920	·909	·977	+
17.	·436	·981	·682	·782	1·020	·861	·827	+
18.	·261	·740	·862	·822	·660	·768	·776	+
19.	·393	·561	·707	·658	·740	·686	·721	+
20.	·102	·167	·254	·235	·582	·321	·365	
Controls	·104	·211	·370	·317	·473	·361	·406	

Table IV.

Rainfall figures for the time of the experiment.

	inches		inches		
January	13·23	July	8·26		
February	6·67	August	14·69		
March	4·45	September	6·35		
April	15·98	October	29·46		
May	9·71	November	16·69		
June	13·81	December	8·14	Total	147·44

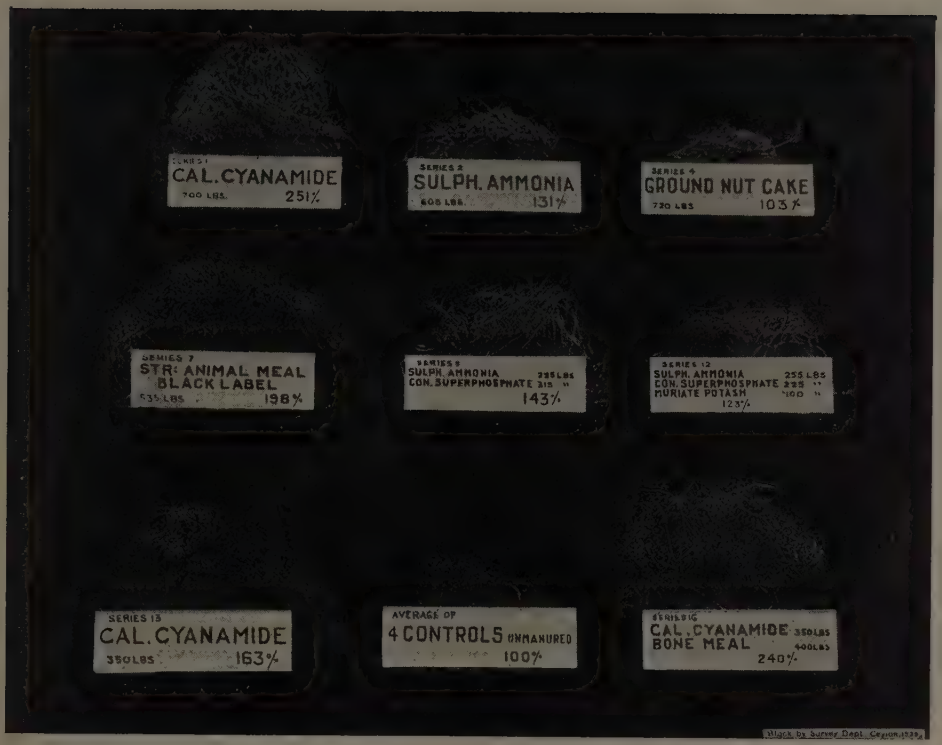
SERIES 1
CAL. CYANAMIDE
700 LBS. 251%
SERIES 2
SULPH. AMMONIA
605 LBS. 131%
SERIES 4
GROUND NUT CAKE
720 LBS 103%
SERIES 7
STR: ANIMAL MEAL
BLACK LABEL
535 LBS 198%
SERIES 9
SULPH. AMMONIA 225 LBS
CON. SUPERPHOSPHATE 315 "
143%
SERIES 12
SULPH. AMMONIA 255 LBS
CON. SUPERPHOSPHATE 225 "
MURIATE POTASH 100 "
123%
SERIES 13
CAL. CYANAMIDE
350 LBS 163%
AVERAGE OF
4 CONTROLS UNMANURED
100%
SERIES 16
CAL. CYANAMIDE 350 LBS
BONE MEAL 400 LBS
240%

Figure 2.

A NOTE ON BROWN BAST.

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THE following note on brown bast disease of rubber is of the nature of a progress report and in it are collected in brief the results of a number of experiments and pieces of circumstantial evidence which appear to the writer to support his theory of the cause of the disease. For various reasons the work in Ceylon has not been continuous and some of the experiments mentioned date back to 1923. Work is being continued, but it is thought that the stage arrived at permits of the publishing of a brief account of a theory evolved during the past six years.

The general concensus of opinion is that the disorder of the cortical tissues of *Hevea brasiliensis* which is commonly called brown bast is physiological in origin. Investigations into the causes of brown bast have been carried out by workers in practically every country in which rubber is grown, and only one investigator, Keuchenius in Sumatra, has supported the theory that the disease is caused by an organism. The present writer supports the majority view but is of opinion that no satisfactory explanation of the mechanism of the disorder has yet been offered. It has been stated that the cause is overtapping (Rands 1) or the withdrawal of excessive amounts of latex or water (Sharples and Lambourne 2) or that the disease is a necrosis of the phloem analogous to that found in potatoes (Horne 3). It is not intended to discount all or any of these ideas, but, while Rand's wound gum and necrosis of the phloem are both to be found in affected tissues, it is felt that none of the theories supplies a satisfactory explanation of the final cause of the disease. Probably all the theories contain a part of, but not the whole of, the truth. The more important hypotheses already propounded will be mentioned in connection with experiments carried out in Ceylon and elsewhere which seem to have a bearing on the points in question.

THEORIES ALREADY ADVANCED.

1. *Bacterial or fungal causal agent.*—Brown bast was originally confused with stem canker or claret-coloured canker, but the distinction has been recognised for a number of years. Practically every worker who has studied the disease has searched for a causal agent. Numerous organisms have been isolated from infected cortex but there has been no constancy about the

bacteria or other organisms obtained, and no one except Keuchenius claims to have succeeded in infecting a healthy tree by direct inoculation.

Inoculation experiments were carried out in 1923 on a small scale by the writer but it was not found possible to transfer the disease from a diseased to a healthy tree. It is not proposed to give details of the experiments as the writer's work on brown bast has led to the opinion that the disease is physiological in nature. No one has yet confirmed the results claimed by Keuchenius.

2. *A virus disease.*—Horne (3) concludes that the disease is a disorder of the phloem (phloem necrosis) probably analogous to that associated with virus disease of potatoes.

3. *A physiological disease.*—(a) *Excessive wounding of the cortex.* On the results of a number of tapping experiments Rands (1) concluded that the disease was caused by excessive cutting of the cortex by tapping. (b) *Meristematic activity.* Sanderson and Sutcliffe (5) believe that the disorder is due to meristematic activity set up by overtapping. (c) *Depletion of the water supply.* Depletion of the water supply of the tissue by the withdrawal of too much latex is suggested as the cause by Sharples and Lambourne (2) who base their conclusions on a large number of tapping experiments.

4. *Phloem necrosis.*—No systematic series of experiments has been made to test the possibility of the disease being caused by a virus, but in 1923 an attempt was made to infect healthy trees by injecting into the cortex juice which had been expressed from affected tissue. A considerable quantity of bark was peeled off a tree which was badly affected and the juice was expressed. This was divided into two portions, one of which was sterilised in an autoclave. Injections were made into the bark of six trees, untreated extract, sterilised extract, and sterilised distilled water being used. The injection was made by means of pieces of narrow glass tubing bent into the shape of an L. A small piece of bark was removed by means of a cork borer and the tube containing the liquid was inserted. Each tree was inoculated with all three liquids. Discolouration mainly in the region of the cambium was found in all cases, and, in the case of both sterilised and unsterilised extract, the discolouration spread upwards and to a certain extent downwards in the youngest wood. In no case did any of the usual symptoms of brown bast appear, and after the original discolouration there was no spread. It is not contended that the above preliminary trial was at all conclusive, but, owing to the completely negative evidence afforded and to the fact that it was discovered that necrotic sieve tubes could be found in bark from tapped trees which had no disease, it was thought that a more fruitful line of work lay in purely physiological experiments.

PHYSIOLOGICAL THEORIES.

Effect of tapping on incidence of brown bast. It has been the experience of all that a severe tapping system favours development of the disease, and it seems unnecessary at this stage to reiterate accounts of the numerous experiments carried out to prove this. Various types of severe tapping systems have been employed in attempts to produce brown bast experimentally, *e.g.*, two superimposed cuts tapped six times a day, one cut on full circumference tapped daily, etc. All have been successful in setting up disorders and moreover Ashplant has shown that deeper tapping favours the disease. There is also abundant estate and experimental evidence to show that daily tapping on a half circumference is productive of more cases of disease than alternate daily tapping or tapping every third day. These facts have been advanced in support of the theories that the disease is due either to excessive extraction of latex or to excessive wounding of the cortical tissues. These two theories will now be considered separately.

WITHDRAWAL OF EXCESSIVE AMOUNTS OF LATEX.

This is probably the most widely credited among the numerous causes suggested. The theory of Sharples and Lambourne hinges on this, although it is the water content of the latex rather than the caoutchouc which is considered of importance. Bobilioff has suggested that the latex system may have the function of a reserve of water, and, if this is accepted, any depletion of this supply might be expected to have disastrous effects on the surrounding tissues, especially during the dry season.

It is also a well-known fact that the high rubber content of latex at first obtained from newly-opened cuts gradually falls until an equilibrium is set up. Daily tapping produces a latex with a lower dry rubber content than alternate-day tapping. This lends some support to the contention that the water content of the latex is the more important constituent in this connection, as daily tapping produces more disease and more water is extracted in any given time by this method.

So far the evidence seems to favour the assumption that excessive withdrawal of latex is in some respects concerned with the disease. The following experiments were designed to test this:—

Experiment (*a*).—An attempt was made to regulate the flow from one of two equal cuts on a number of trees, but at the same time to treat all cuts alike as regards tapping. This being a preliminary experiment, only ten trees were used. Two cuts of equal length, about one-third circumference and at the same height, were opened one on either side of each of the trees These cuts were tapped twice daily. The normal flow of latex was permitted from one of the cuts but the flow was restricted on the other by the immediate application of alcohol. Flow was not

completely stopped by this means but considerable reduction was effected. Spirit was applied to the other cut when latex was collected so as to equalise as far as possible the alcohol treatment. After the lapse of a month the trees were examined. Four of them had brown bast, two of those being affected on both sides and two on the cut with the restricted flow only. A week later another tree had developed the disease on the restricted side. This was thought to indicate that the amount of latex withdrawn was not such an important factor as had been imagined, but, as the experiment had been carried out on such a small scale, the evidence could scarcely be accepted as significant. For this reason experiment (b) was started.

Experiment (*b*).—This experiment was carried out at the Experiment Station, Peradeniya, by Mr. Holland of the Department of Agriculture, to whom thanks are due for the data supplied. It may be explained that the Rubber Research Scheme owns no adult rubber trees and is dependent on estates or the Experiment Station for material on which to experiment. The experiment was identical with experiment (a) except that daily tapping only was employed and that yield records were kept as volume of latex. A larger number of trees was employed, viz., 108. The amount of latex obtained from the cuts from which the flow was restricted was found to be almost exactly one half of that obtained from the others.

After five months an examination revealed the following:—

	X Cuts (free).		Y Cuts (restricted).
Nearly dry.	20	...	22
More advanced stage	21	...	10
	41	...	32
Percentage of cuts affected.	40%	...	31%

An examination made after the experiment had been running for a year (April 1927) showed the following:—

	X Cuts.		Y Cuts.
Partially dry	22	...	17
More advanced stage	15	...	16
Bad cases	6	...	1
	43	...	34
Percentage of cuts affected	42%	...	33%

These results tend at least to show that the amount of brown bast is not proportional to the amount of latex withdrawn. The Y cuts from which was withdrawn only 50 per cent. as much latex as from the X cuts showed after five months only 22 per cent. less cases of brown bast. After twelve months the difference was 21·4 per cent.

The experiment at the time of writing is still being carried on and an effort is being made to restrict the flow from the Y cuts still further. Evidence of a somewhat similar nature can be obtained from a report by Ashplant on "Deep tapping *versus* shallow tapping." The following is reproduced from the monthly report of the Rubber Specialist in South India for April 1926.

	Daily tapping.		Alternate-day tapping.	
	Deep	Shallow	Deep	Shallow
Average annual yield per 100 trees ($\frac{1}{4}$ cuts) in lbs.	616	134	386	80
Percentage of trees per annum developing brown bast	12%	6·3%	6·3%	4·2%

Ashplant writes: 'Though so mild as seemingly to constitute no strain worth speaking of on the tree these daily shallow tappings which withdrew only from $\frac{3}{4}$ to 1 lb. of rubber per tree per annum provoked quite as much brown bast as the alternate-day deeper tappings that withdrew from 3 to 4 lbs. per tree." Later he says: "We have evidently to do with other factors than excessive latex withdrawals, for there is no proportionate relation between the percentage of brown bast and the amounts of latex withdrawn." The above evidence, it is thought, warrants the statement that, although the excessive withdrawal of latex may have some influence on the incidence, it is not the principal cause. Increase in amount withdrawn bears no relation to increase in percentage of trees affected with the disease.

EFFECT OF AMOUNT OF CUTTING.

It might be deduced from Ashplant's experiment mentioned in the last paragraph that the amount of cutting is the real cause and experiments on the following lines were started with a view to obtaining further information.

Experiment (*c*).—Thirty trees were used. On either side of each a square of bark 1 sq. foot in area was isolated by a half-inch channel extending to the wood. A cut was opened on each square extending right across the isolated panel. The cut on one side of each tree was tapped to the wood, and the other to the normal depth. Tapping was done twice a day. After a week examination showed that the cuts tapped to the wood were all practically dry and that the yields from the others had also decreased to practically nil. After a month a brown bast examination was made. All the cuts tapped to the normal depth except two showed symptoms of brown bast. Most of the attacks were slight owing no doubt to the short duration of the experiment, but they nevertheless showed all the initial characters of

the disease. Of the cuts tapped to the wood, only three showed definite symptoms of brown bast. The diseased portion in all the latter cuts was at the top of the cut and it was found that here the cuts had not been tapped completely to the wood.

In this experiment the cuts which showed less brown bast had actually been subjected to more severe cutting than the others as they had been tapped to the wood and more cells had been cut through. The number of cuttings was the same in both cases. The amount of cutting is, therefore, not the cause of the disease.

Further evidence that such is the case can be obtained from Sharples and Lambourne's paper. On p. 317, referring to the isolation channels employed in the isolation method of treatment, the writers state: "It is worthy of remark that a considerable reduction in amount of total rubber is found when wide or deep depressions are utilised for isolation cuts . . . . . for when the cut being tapped comes within two inches of the depressions the majority of the trees go dry or yield only a small amount though brown bast cannot be detected. Such cases provide instances of large wounding influence with a decrease in yield but no increase in brown bast, indicating that the amount of latex extracted is the factor of greatest importance in the initiation of brown bast. The conclusion drawn by the writers has already been dealt with and it is thought that this with the evidence of the experiment mentioned above is sufficient to warrant the statement that the amount of cutting is not the controlling factor.

LOCATION ON THE CUT OF THE EARLIEST SYMPTOMS.

It has been stated that brown bast appears very often at the top end of the cut. While making the census of cases of disease over 1000 trees mentioned later in the article, the writer also observed that the ends of the cuts were often affected first. This, however, was not constant, and in many cases it was impossible to say which was the point of origin as a large area had become affected. It would also appear that the disease in some cases originates a short distance below the cut and is only seen when the cuts moves down the tree. This has already been stated by Petch. It must be accepted, therefore, that brown bast may originate anywhere on the cut or immediately below it.

EFFECT OF THICKNESS OF SHAVING REMOVED DURING TAPPING.

It is generally known that an increase in latex yield is obtained by slightly increasing the bark consumption above that allowed on the average estate in Ceylon. Thus with thirty five cuts to the inch the yield obtained in a certain time is less than

would be obtained if one inch were consumed every twenty tappings. (Let it be understood, however, that an increased consumption of bark is not being recommended. The question under discussion is only one factor in bark economics.) The most recent reference to this was made by Bendixen (7). He states: "As regards the number of cuts per inch, it has been found that about four times as many trees developed brown bast by tapping forty cuts per inch as by tapping thirty cuts per inch." Sanderson and Sutcliffe (5, p. 22-23) should be consulted in this connection. The reason that the full potential yield of a cut is not obtained when excessively thin shavings are removed no doubt lies in the fact that all the plugs of coagulated latex which form in the ends of the cut vessels are not removed. A number is no doubt cut through. One might expect the plugs in the narrower vessels to be more easily cut through or left as the wider variety would pull out either when the scrap was removed or during tapping. The effect of this unequal release will be discussed later as it forms the basis of the writer's theory of the cause of brown bast.

That the diameters of different vessels in the same tree vary has been shown by Ashplant, and the present writer has also investigated the question. The following are the results obtained from two trees. These were selected at random from about two hundred examined. The measurement was made by eyepiece micrometer and by this method extreme accuracy was probably not obtained. Experimental error, however, cannot account for the great differences observed between the bores of the different vessels. In the case of each tree three longitudinal tangential sections were examined and with tree C 17 thirty measurements were made and with tree B 5 seventeen measurements.

Tree C 17	Mean diameter	24·7,	microns
	Max. do	36·0	do
	Min. do	14·4	do
Tree B 5	Mean do	22·8	do
	Max. do	26·4	do
	Min. do	14·4	do

ARTIFICIALLY-PRODUCED BROWN BAST.

Brown bast has been produced through heavy tapping by most of those who have studied the subject. Rands in particular used very drastic means. The writer has at various stages of the work had isolated portions of bark tapped several times a day and in all a condition in some respects resembling brown bast has been produced. One experiment has already been mentioned in connection with the effect of the amount of cutting. In all cases where the cut extended right across the isolated portion and down to the cambium certain of the symptoms were present but the

general appearance did not resemble a typical case of brown bast. The bark ceased to yield latex, and in a few cases the colour changed to a dull yellow but nothing further was observed. Continued heavy tapping failed to produce the disease in its characteristic form. There was no water-logging, the typical brown specks and lines were not present, and there was no vertical cracking of the bark due to meristematic activity. Rands and Bobilioff have both found similar irregularities. The former author gives a table of notes on the appearance of the bark in a number of his trees, but in a large number of these there would appear to be only very slight evidence to show that the tree had developed the disease. The writer is of opinion that true brown bast was not present in a number of cases where it was stated to be present. During the present work a tree has not been stated definitely to have brown bast unless all the symptoms were present. An exception was made in the case of vertical cracking of the bark and nodule formation as some of the tests were not continued sufficiently long for these to become evident. It may also be stated that vertical cracking is not so common an occurrence in the wet Kalutara district where most of the tests were made as in the drier districts.

EFFECT OF SEASON AND ENVIRONMENT.

Keuchenius has stated: "A number of observations have convinced me that, with lack of light and with increase of moisture, brown bast occurs in far more serious form . . . ." Sharples and Lambourne argue that the above supports their theory that the disease is due to the withdrawal of excessive amounts of water, because a higher yield and hence more water is obtained during the early morning.

The writer has not studied the effect of abundance or scarcity of water in any detailed experiments, but in Ceylon the estates which suffer most severely from the affection are those situated in the drier districts such as Kurunegala, Matale and Uva. Two estates visited by the writer, in two of the disricts, showed approximaely 25 per cent. of their trees with brown bast. During 1923-25 inclusive an annual census of cases of brown bast was made over ten acres (1000 trees) on an estate in the Kalutara district. The figures for increase in number of cases have already been published and as they would appear to have no bearing on the present subject they need not be repeated. Part of the area, however, was subject to periodical flooding due to the overflowing of the Kalùganga. A number of the trees in this area was lost annually by root affections, principally *Sphaerostible repens*, and all had an unhealthy appearance. The cortex in most was of a dark red colour and sodden. The percentage of these trees affected by brown bast was almost exactly the same as that found on the higher land. Excessive moisture

did not coincide with a large amount of disease. Sanderson and Sutcliffe are also of opinion that any seasonal increase in number of cases is not due to a plentiful supply of water.

Sharples and Lambourne give figures to show that there is frequently a sudden rise in the number of cases of disease towards the end of, and just after, a prolonged dry period, and suggest that trees which have maintained a high yield throughout such a period have a tendency to develop brown bast. This is taken as evidence that depletion in water supply by tapping is a contributing factor in the incidence of disease. It is thought that another meaning can be got from this and the matter will be discussed again when the writer's theory is elaborated. Sanderson and Sutcliffe (pp. 27-28) should also be consulted.

UPSETTING OF PRESSURE RELATION BY TAPPING.

The effects of the following have now been briefly mentioned:—(1) different tapping systems, (2) environment and season, (3) withdrawal of large amounts of latex. (4) excessive cutting, (5) thickness of shaving. Circumstantial evidence in support of the theory of upsetting of internal pressures can be gleaned from these.

Put in as few words as possible, the writer's theory is this: Brown bast is the disorganisation of cells, latex cells, sieve tubes and probably other cortical cells caused by the frequent sudden changes of pressure due to the release of pressure during tapping from some latex cells and the non-release from others. Meristematic activity is secondary and probably can be regarded as wound effect or a natural enclosing of a foreign or a dead particle, in this case the dead cell, in a special tissue so that it is isolated from the surrounding living tissue.

It is argued that, frequently during tapping and especially when very thin shavings are removed, all the latex vessels are not opened at each cutting. The fact that a slight increase in thickness of shaving gives a measurable increase in yield of latex supports this. As already argued, the plugs of coagulated latex which seal up the open ends of the vessels are not all removed but are in some cases cut through. It has been stated by Ashplant that the diameter of a latex vessel may vary considerably throughout its length, but it is also true that the variation is much less than that found between different vessels in the same section. A vessel which is classed as narrow at one point will never be found to become very wide at another point.

It can therefore be reasonably assumed that at least during a few consecutive months' tapping the same vessels will often remain plugged, as they will have the narrower plugs and therefore plugs which will not pull out so readily. That latex is under pressure in the vessels is evidenced by the nature of the flow when a cut is tapped. The release of this pressure in one vessel

while the pressure in its neighbour is maintained must of necessity cause a severe strain on the cells in the immediate vicinity. Blackman's theory of suction pressure can be applied here. The actual effectiveness of the osmotic pressure of any cell is represented by the formula P—T, where T represents the total potential osmotic power and T denotes the counter pressure exerted by the cell wall plus the pressure of the surrounding turgid cells. If the pressure inside the neighbouring cells, i.e., their turgidity, falls for any reason, T becomes diminished and P is permitted to call into play more of its total power. The 'unreleased' latex-cell will therefore absorb water from the surrounding cells and expand until an equilibrium is reached for the new value of P—T. During this process the surrounding cells, be they sieve tubes or other cells, suffer, as in all probability does the latex vessel which has had its pressure already released. Water will be drawn from them to satisfy the new pressure relations set up in the unreleased latex-cell. It is suggested that this frequent withdrawal of excessive amounts of water from the surrounding cells produces such a condition that coagulation of their protein contents takes place and is followed by the loss of functional activity and death. In such a state a cell can be said to be necrotic. The affected cell will become the centre of meristematic activity and probably later the core of a nodule.

It has been said that high-yielding trees are more liable to brown bast than trees of a lower-yielding capacity. Sharples and Lambourne have shown that high yielders in a plot usually develop the disease sooner than the others and so at first it would appear that the above is the case. This is in line with the above theory as we are here dealing presumably with higher pressure or greater volumes. Where, in such a tree, a vessel is left unopened during tapping, the upsetting of pressures is accentuated and the necrotic condition will occur earlier. With poor trees the pressure is less or the capacity is less and a larger number of tappings and releases are required to upset the balance sufficiently.

Again, brown bast is much more prevalent in dry districts than in those with heavier rainfall. Sharples and Lambourne (2) and Sanderson and Sutcliffe (5) call attention to the effect of the dry season. Under these conditions much more drying back of the cortex from the cut surface occurs between tappings. The plugs of coagulated latex are larger and unless special allowance for this is made in the thickness of shaving removed a great many trees will have latex vessels only irregularly released and so run the risk of disease.

The withdrawal of large quantities of latex has been and usually still is given as the cause of disease. According to the present theory the disease need not necessarily follow such treat-

ment provided the pressure relations are not unduly upset, *i.e.*, provided all vessels are released at every tapping. The fact that brown bast did not become a serious disease during the very heavy daily tapping which was in vogue about 1910 lends support to this. Conservation of bark was not then studied and very often a foot of bark was removed from each cut during the year. Some similar effect may be seen on inspection of certain village holdings. Little effort is made there to conserve bark, and brown bast is in most cases not more prevalent than on many European-owned estates. Bad tapping there is, and many of the trees are masses of nodules, but investigation will show that these excrescences are more the result of tapping wounds than anything else.

The amount of wounding by tapping is also put down as the cause of the disease. A small but nevertheless fairly conclusive experiment was tried on Culloden Estate and the results have already been given. The two cuts were tapped at the same time and the only difference was that one was tapped down to the wood. Both therefore were tapped equally often but the latter was actually wounded more than the other, *i.e.*, more cells were cut through each tapping and still showed less disease.

This experiment, it is thought, also provides further support to the theory. The cuts which were tapped to the wood ran dry after about a week and no brown bast was found present. Continued tapping did not produce the disease. There was no latex and therefore no unequal release of pressure. On the other cuts tapped to the normal depth latex was not directly withdrawn from the inner cortical layers on any part of the panel and so the cut continued to yield for a longer time, sufficiently long, in fact, for all the trees with the exception of two to show at least slight symptoms of the disease.

In this experiment it was assumed that twice-daily tapping would ensure the removal of all plugs at every tapping, as they would not be completely formed and still soft. No examination was made to see whether this was the case or nor but it must be remembered that with normal tapping there is always a layer of bark 1 mm. or so in thickness left along the back of the cut. Latex vessels in this are not opened and so the innermost latex row which is drawn on must always have a complete row of unopened cells next to it.

SPREAD OF THE DISEASE.

It is the general opinion that the disease may spread after the cessation of tapping, although protagonists of some of the physiological theories have denied this. It is possible that the areas more remote from the point of first attack only show the disease in unmistakable form some time after tapping has been stopped. The upset in pressure relations may already have

caused damage to certain cells; the initial stages of brown bast are not always easy to detect. Cases have been cited where the brown bast on a cut has been linked by a band of diseased tissue to a wound caused by the breaking off of a branch some distance higher up the tree. The writer has not seen such a case but has found that where a cut has been opened above an old affected cut the new cut usually develops the disease in a very short time. This points to the disease travelling upwards to the wound rather than from the wound down to the cut.

Bobilioff has shown by experiments on a budgraft which had a scion producing tinted latex that latex travelled to a newly-opened cut from considerable distances. In this a wound such as that caused by the breaking of a branch would drain the latex of all the cells opened. Should it happen that a cut further down the tree and in a position crossed by these emptied vessels is affected with the disease it is quite reasonable to suggest that in a number of cases this extra upsetting of pressures is sufficient to complete the work of a destruction already started below. That the disease follows the direction of the vessels in such cases seems fairly certain from the diagrams published, as the wound is found above and slightly to the right of the affected cut, and latex vessels are known to ascend in a slightly clockwise direction rather than perpendicularly. The possibility that the disease originated at the wound and spread down seems rather remote as the further away from the wound the less the upsetting of the pressures becomes and the more easily is the balance restored, provided no diseased area is crossed. Also in the case of the breaking off of a branch the wounding is not repeated so that there seems scarcely sufficient stimulus to cause the disease at any great distance from the source. Wounds have been known to cause a local condition resembling brown bast, but, as far as the writer's observations go, in no case has the disease spread to any extent.

PREVENTION AND TREATMENT.

The above arguments tend to show that where there is tapping there will remain the tendency to brown bast and that, it is unlikely that any tapping system can be evolved which will ensure complete immunity. In the drier districts especially, it is thought that daily tapping in alternate months or some such system would be preferable to regular alternate-day tapping. There is less time for drying back of the bark between tappings and so plugs formed in the opened ends of the vessels have less chance of remaining. It is also indicated that there is a limit to the thinness of shavings removed by the tapper. Another thing which might be useful, the adoption of which will not appeal to many planters, is an isolation cut, a single cut not a channel, made down to the wood and running down either side of the panel.

This puts a barrier between the two panels on a tree, and if tapped up to at both ends of the cut it will ensure that at least at the ends of the cut no released vessel is situated next to an unreleased vessel.

The method of treatment which has proved most satisfactory in Ceylon is that advocated by Mr. J. Mitchell of the Rubber Research Scheme (see 8). It consists of a combination of the scraping and isolation methods. Great detail will not be gone into here as the method is fully described in Mitchell's articles but the method in brief is as follows: The limits of the diseased area are found and the whole of the affected cortex is scraped away to such a depth that little pinpricks of latex begin to appear. A single isolation cut down to the wood is then made all round the treated area and the whole is painted with disinfectant.

Except in the drier areas brown bast has been very often considered, probably unjustifiably, as of minor importance in Ceylon, and large-scale treatment on estates has never been considered as imperative as has been the case in other countries. For this reason the writer cannot speak with authority on treatment by the isolation method. Any treatment carried out on estates has amounted to the scraping of trees which have reached the stage where at least a large part of the panel is affected. In the writer's opinion, for mild cases or, rather, cases observed in the earliest stages, the isolation method of Keuchenius is effective, but where the affected area is large enough to prevent further tapping of the panel the method is best combined with scraping. This scraping when done by trained men results in no damage and ensures a rapid and even replacement of the diseased tissues. Where a small patch is treated by isolation tapping can be continued and the scraping is replaced by the gradual removal of the affected cortex.

It may appear strange that while suggesting a physiological origin a method of treatment designed against an infectious disease is advocated. A little consideration, however, will show that the two are not incompatible. When the narrow isolation cut is made it immediately fills up with latex and in a short time a barrier of rubber is formed which to all intents and purposes is impenetrable. If the channel has been cut to enclose all the area actually affected it will be seen that any alteration of pressure relations within the isolated portion of cortex can have no effect on the tissues outside. The isolation cut is tapped across and so no further upsetting of pressure is likely at the boundary. Further spread can therefore only take place because the whole of the affected area has not been enclosed or through a fresh outbreak.

LINES ON WHICH FURTHER WORK IS TO BE CARRIED OUT.

Tapping experiment.—The experiment requires that three cuts be opened on each tree, each cut extending to one-quarter circumference and all being at the same height. On cut A isolation channels ½-inch wide are to be cut down either side of the panel. On cut B channels are to be cut down either side and at the bottom (about 12 to 15 inches down). On cut C no channels will be cut. The cuts are to be tapped daily and sufficiently thick shavings will be removed to ensure that no vessels remain plugged after any particular tapping. All the cuts will extend across the panels marked out and all will be tapped down to the cambium. From theoretical considerations no brown bast should appear on cuts A or B, although B should go dry at an early date. Brown bast that develops should start at the ends of the C cuts as only here is a latex vessel which is not released at every tapping.

Relation between range of variation in latex-vessel diameter and liability to disease.—It is thought that there might be some correlation between the coefficient of variation in latex-vessel diameter and liability to brown bast. The point is to be investigated.

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AN IMPROVEMENT ON ACETYLENE FOR THE ILLUMINATION OF THE OPTICAL LANTERN.

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THE efficiency of an optical or magic lantern is limited by the source of illumination. There are many sources of light for the lantern, and the more intense the light without excessive heat the more satisfactory is the projection of the picture. No matter how perfect may be the condenser and objective, unless the source of light is brilliant the perfections of the component parts of the instrument are lessened. Where electric current is unobtainable for illumination the best of poor substitutes has generally been considered to be acetylene gas. The gas is generated from calcium carbide in a container, collected in a rubber bag to ensure more or less even pressure and distributed to the burners through a rubber tube. The burners are generally four in number placed one in front of the other, immediately behind which there is invariably a totally inadequate polished metal reflector.

The writer has for many years used acetylene under varied conditions as an illuminant for the optical lantern and consequently may claim to know the limitations of this source of light. It is only recently that he has hit upon a more convenient, more satisfactory and equally accessible form of illumination which may not be known to the local operators of lanterns. In order that this satisfactory source of light may be fully appreciated it is not irrelevant to detail a few of the limitations of the usual acetylene gas outfit which is supplied with lanterns.

1. Rubber tubing perishes rapidly in this climate.
2. The rubber bags also perish.
3. The rubber bag either gives too much or too little pressure of gas. Each burner pipe has a screw for adjusting the flow of gas to the burner, but those who are qualified to judge will agree that constant adjusting of the four screws according to the fluctuation of the pressure of gas is a source of annoyance and tends to blind the operator temporarily every time he makes the adjustment. It must not be forgotten that the operator has to regulate the inflow of water to the generator, regulate the gas supply in the rubber bag, regulate the flame at the burners, follow the lecturer, put in the slides correctly and focus them on the screen. He is fully occupied, and to be blinded for a few moments at frequent intervals does not add to the smoothness of his work.

4. The burners and burner pipes require regular cleaning.
5. The generator is never large enough.
6. The heat generated is great. The lantern becomes too hot to touch; care has to be taken that neither the condenser nor the slides crack; the generator also warms up to untouchable temperature.
7. The metal reflector is almost useless. A mirror reflector improves the illumination 40 per cent. A mirror reflector from a motor cycle acetylene lamp has been used with success for several years by the writer.
8. After each lecture all the working parts of the gas apparatus have to be carefully cleaned.
9. If there are any leaks in the lighting system the atmosphere becomes unpleasant.

By using the electric current from an ordinary six-volt motor car battery in conjunction with a special adapter and a Maza 72-watt 6-volt projection globe, a more intense, concentrated, steady and altogether satisfactory light is obtained. There is no excessive heat, every part of the lantern can be handled; no part requires the attention of the operator. The light is switched on and centred, and the operator has nothing more to do than pay attention to the lecturer and feed the lantern with slides. There are no parts to clean.

The special adapter is a screw socket to fit the screw-base of the Maza globe and two insulated wire-leads to fix on the terminals of the battery. This accessory may be bought locally for Rs. 14-00 or made by an ingenious person for very much less.

The cost of the necessary outfit is.

One six-volt battery.....	Rs.	75-00
(First charging of same Rs. 5-00; subsequent charging Rs. 3-00).		
Special adapter.....	,,	14-00
One Maza 72-watt 6-volt projection lamp.....	,,	12-50
	Rs.	101-50

The lamp can be held and adjusted in the lantern by the ordinary clamp used in a chemical laboratory. A fully-charged battery will give approximately four hours' illumination. At the cost of Rs. 3-00 for charging, the price of illumination is 75 cents per hour. The difference between the cost of the acetylene and electric lighting outfits is

Electric outfit.....	Rs.	101-50
Acetylene generator and accessories	,,	75-33
	Rs.	26-17

By the purchase of a 200-watt 50-volt Maza projection lamp and a resistance up to 250 volts, municipal electric current may be used for perfect lantern illumination.

SELECTED ARTICLES.

MR. ORMSBY-GORE AND TROPICAL DEVELOPMENT.*

THE attributes of a true research worker are high intellectual endowment, a desire for knowledge, a capacity for accurate observation and selection of relevant facts and data, a mind unbiassed by preconceived ideas, sound judgment, and breadth of vision. We rarely associate such a combination of qualities with our politicians. Special pleading is the enemy of truth. Occasionally, however, even a politician may free himself from the shackles of political expediency, and put the general interest before self-interest, mankind before country, and country before party. To distil the essential wisdom from the heterogeneous ingredients of party controversy requires the courage of statesmanship, the penalty of which is not infrequently loss of office and political oblivion. For office is a party spoil.

These reflections savour of the platitudinous, but they are occasioned by reading the remarkable report on his visit to Malaya, Ceylon, and Java which the Parliamentary Under-Secretary of State for the Colonies, Mr. Ormsby-Gore, has just completed for presentation to Parliament. This is the fourth report of its kind, based on personal visits, for which Mr. Ormsby-Gore has been partly or solely responsible. In 1922 he accompanied his predecessor in office (Mr. Edward Wood, now Lord Irwin) to the West Indies and British Guiana. Two years later, Mr. J. H. Thomas, then Colonial Secretary, made him Chairman of the Parliamentary Commission which visited East and Central Africa, and in 1926 he made a tour of the four British Colonies in West Africa. In the course of these tours alone, therefore, he has formed direct personal contact with the most of the dependencies, the affairs of which fall within the scope of his ministerial responsibility. His personal acquaintance with the countries of the Empire does not end there, however. Before the War he visited South Africa and Rhodesia, and during the War he served in Egypt, later as intelligence officer in the Arab Bureau, and finally as Assistant Political Officer in Palestine. Probably no other minister has been able to bring to bear upon his task such comprehensive first-hand acquaintance with our non-self-governing dependencies and the mandated territories for which we are responsible.

Had such tours been made solely with the object of obtaining first-hand information for facilitating Mr. Ormsby-Gore's own work at the Colonial Office, they would have been amply justified. Fortunately, he has a wider conception of his responsibilities. The knowledge he has gained he puts at the disposal of us all. He tells us freely what opinions he has formed, what modifications in policy he would advise. He gives us facts with strict impartiality. He expresses his opinions with no attempt at dexterous ambiguity, and certainly with no air of infallibility. On the contrary, he invites criticism, having first provided us with the necessary knowledge upon

* From *Nature*, January 12, 1928.

which to base it. These are the methods of the research worker, the methods which make for progress. They are certainly the only methods which will ensure that colonial development will proceed on right lines.

In each successive report on British Colonies, Mr. Ormsby-Gore has advanced his claim to be considered a research worker, not, it is true, as an original investigator in a specialised branch of science, but in the wide and complex fields of human relationships and the relation of man to his environment. In these four reports on the colonies are set out with admirable clarity, completeness, and in due perspective the multiplicity of problems confronting our colonial governments, together with what has been done towards their solution and what still remains to be done, what could have been done had our existing knowledge been properly brought to bear upon them, and problems which are likely to make the greatest demands on our research workers. Considered as a comprehensive whole, these reports constitute a great achievement. They can, with sincerity and truth, be described as a monumental and magnificent research.

In the introduction to his report on Malaya, Ceylon and Java, the occasion of this review, Mr. Ormsby-Gore reminds us that "British possessions in the tropics are at widely different stages of development, but each and all have many problems in common, and each has something to learn from the experience and practice of others." Accordingly, in this as in previous reports, he concentrates on particular features; for example, the state of agriculture and animal husbandry, public health, education, forestry, and transport, hoping that their study by the comparative method may reveal facts and suggestions which may prove useful to other colonies. A separate chapter is devoted to rubber; first because it is the principal economic crop of Malaya; and, secondly, to comment on the results of the Stevenson Scheme of Restriction of output of this commodity. All these subjects possess a special interest for scientific workers, and in dealing with each of them, Mr. Ormsby-Gore lays stress on the contributions which science has made or can be expected to make to the development of the services or industries with which they are related.

Not the least valuable parts of the report are those dealing with geographical, historical, and economic facts relating to the colonies. They cannot fail to interest anyone with the slightest desire for knowledge of conditions of tropical life. They are presented also in such a way as to fix outstanding facts in our minds. British Malaya, we are told, covers a total area a little less than that of England. Its total population is today probably about four millions. The Dutch Colony of Java, climatically resembling British Malaya, covering a smaller area, contains a slightly larger population than England, although most of the Javanese (the Handbook of the Netherlands East Indies gives the proportion as more than 70 per cent.) are engaged in farming. Practically the whole of Java is under cultivation, whereas the greater part of the Malay Peninsula is still virgin forest, and a large proportion of the food supplies for its inhabitants has to be imported. Yet, although the population density of Java is eleven times, and its actual population nearly ten times, that of British Malaya, its overseas trade is less than that of the British Colony. For 1926 the imports of British Malaya were valued at £117,000,000, and the overseas exports at £147,000,000, the corresponding figures for Java being £72,000,000, and £131,000,000, all figures being exclusive of bullion and specie. "These remarkable totals (for British Malaya) exceed those of the total external trade of the whole of the rest of the Colonial dependencies put together. The value of exports per head of the population of British Malaya for the last two years has exceeded that of any other country in the world, and is higher even than the figure of New Zealand, which leads the self-governing Dominions in this respect."

Tin and rubber are the two factors determining this result for Malaya. "In 1927 nearly half the world's tin supply was mined in Malaya, and about 70 per cent. of the supply of refined tin was shipped from the smelting works in Singapore and Penang." The net export of crude plantation rubber from Malaya in 1927 was 240,000 tons, representing more than 42 per cent. of the total exports of rubber-producing countries. Soil fertility is the main factor determining the high population density of Java. The mountain region in Java consists entirely of volcanic rocks which disintegrate rapidly in the warm, humid climate, and thereby enrich the soil. There are other contributory factors to be taken into account. The pirates of the Straits may have for centuries deflected Indian and Arab traders and settlers from Malaya to Java, while the efficiency of the Dutch colonial scientific and technical services in Java has resulted in vastly increased yields per acre and facilitated population increase. "The island of Java," says Mr. Ormsby-Gore, " affords the most remarkable example in the world today of the application of science to the development of the tropics." Obviously, neither piracy nor science can have been of great importance in comparison with the natural fertility of the soil in the determination of Java's high population density. If they had been, we should expect Sumatra to have a much higher density of population than British Malaya, whereas is it only slightly higher.

Nevertheless, what the Dutch have accomplished in Java by the application of science should provide much food for thought for all our colonial governments, and even India. The yield of rice per acre in Java is a little more than double that of British India. Last year (1928) Java expected to produce nearly three million tons of sugar from less than half a million acres of land. Since the establishment of the sugar industry in Java, about the middle of the last century, the yield per acre has been increased sixfold. Java is now the highest sugar producer per acre in the world, and owes its position to the application of plant genetics and soil science. The success of the cinchona (quinine) industry, a virtual monopoly in which is held by Java and Sumatra, has been due almost entirely to very strict scientific controls. The problems presented to the Irrigation Department in Java are some of the most difficult that have ever been presented to hydraulic engineers, Mr. Ormsby-Gore informs us, but they appear to have solved most of them. "As an investment it (the Irrigation Department) has repaid the Dutch East Indies very handsomely, and assuredly it is an outstanding example of the benefits which western science and technical skill can offer." In Buitenzorg, in Java, there are the famous tropical plant research station and a number of other institutions with which more than a hundred scientific workers are associated.

All research for the Dutch East Indies, however, is not centralised in the government research institute at Buitenzorg. The plan of special research institutes, the activities of which are centred in a particular crop, as advocated and put into effect by the Howards in India, has been in existence for a number of years in Java. "The pivot of the sugar industry in Java is the great sugar research station at Pasoeran in East Java," the finest of its kind in the tropics. It has been supported entirely by the industry from its inception. Six other separate agricultural research stations, "proefstations" as they are called, are mantained by the "Algemeen Landbouw Syndicaat," or General Planters' Association, entirely by private subscription and voluntary levies. There are a Tea Research Station at Buitenzorg, staffed by nine European scientific workers; a Rubber Research Institute, also at Buitenzorg, also with nine workers; a coffee 'poof'-station at Malang in East Java with eight; the Besoeki Proef Station at Djember, East Java, for tobacco, rubber, and coffee, with five Europeans; a quinine station at Tjinjiroean, in the Preanger Highlands, West Java; and a small general 'proof'-station at Salatiga, near Samarang, Central Java.

Having been given the opportunity to make himself personally acquainted with the work of the Dutch administration and Dutch scientific workers in Java, noting that the greatest advances in the rubber-planting industry have been made by the United States Rubber Plantations and the A.V.R.O.S. Rubber Experimental Station in Sumatra, that Malaya has a handicap of ten years to make up in the scientific study of budgrafting and related problems of the rubber industry, that "the share of Malaya and Ceylon in total world exports of crude plantation rubber has fallen from 70 per cent. in 1922 to 52 per cent. in 1927, while the Dutch East Indies have increased their share from 25 per cent. in 1922 to over 40 per cent. in 1927, that "Malaya is behind Java in the use of wireless telegraphy and telephony, and its ordinary telephone system is not nearly so complete or far-reaching," Mr. Ormsby-Gore finds the cause in the British administration services. His attitude is reflected in the following comment on the recruitment of administrative officers for these colonies. "The examination seems still to attract in the main those who have specialised at the University in classics or pure mathematics. In the tropics, especially in tropical areas in process of rapid economic development, sound basic knowledge of natural science, biology as well as physics and chemistry, is of ever-increasing significance. The administrative officer has to fit in and co-operate with a large variety of technical officers and . . .he should have some idea of the nature of the problems which confront the latter, who often looks upon him as a member of a senior and pivotal service."

THE FUNCTIONS OF AN AGRICULTURAL OFFICER IN THE TROPICS.*

IT is a great pleasure to be here, and have an opportunity of meeting you all. I welcome, in particular, Sir Francis Watts, our first Principal, and take his presence as a great compliment. To see the College, to have an opportunity of grasping its objectives, of understanding its difficulties, of beholding the evolution of schemes which have been laboriously discussed both by the Governing Body and by the Staff here, make me thankful that at last I have been able to make this journey.

I sometimes wonder if the amount of time, labour and thought that has been put into the founding of this place, or the high hopes that are entertained for it, or the difficulties that have been surmounted in calling it into being, are fully realized. Great administrators such as Lord Milner and Lord Lugard; distinguished Governors of these islands, Sir John Chancellor, Sir Samuel Wilson, Sir Horace Byatt; Cabinet Ministers like the Duke of Devonshire, Mr. Thomas, and Mr. Amery; men of science such as your first Chairman, Sir Arthur Shipley, Sir David Prain, Sir John Farmer, Professor Wood, Dr. Hill; men of business like Sir William Himbury, Mr. Moodie Stuart, Sir Edward Davson, have given their brains and their time without stint to your service.

Colonial Governments and Colonial taxpayers—first, foremost, and most liberally, the Governments and Planters of the West Indian Islands—have contributed to our funds. The British taxpayers, as represented by the Imperial Treasury and the Empire Marketing Board, have done and are doing their full share. Crown Colonies and Dominions are beginning to realize what the College may mean to them, and have begun to contribute. Great British industries, such as the users of cotton and the makers of sugar machinery, have given liberal aid; so have also some Banks and private firms.

Now, though the work of creation is still far from complete, a beginning has been made, and your founders look to you, in full confidence that you will justify their plans, their hopes, and their visions.

When considering what I should say to you this morning, I reflected that the majority of your number are not undergraduates, but men, and men who have already given proof of more than average capacity and industry. I speak on the assumption that you are convinced of the importance of the profession you have adopted, and that you believe implicitly in the possibilities of your work.

These possibilities we have attempted to make as broad as possible. The Governing Body and the Staff here have set themselves to build up an Institution which will be a centre alike of teaching and research. We try to avoid duplicating work which can be efficiently and more economically carried out at home.

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* An address delivered at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, 6th January, 1929, by Sir James Currie, Chairman of the Governing Body of the College. From *The Empire Cotton Growing Review*, Vol. 6, No. 2 April 1929.

We are convinced, however, that, in the main, tropical problems must be studied in a tropical environment. We consider that the average University Graduate has experienced rather a surfeit of lectures, and that he has reached a stage at which direct instruction is profitably supplemented by actual association with specific pieces of research under the guidance of experienced workers.

The majority of the Professorial Staff have got important work in hand, in which you are privileged to share. So has the Cotton Research Station of the Empire Cotton Growing Corporation, which is at your door. The Empire Marketing Board also realize that the College furnishes a convenient centre from which much important investigation can be conducted, and you are thus provided with additional facilities for the observation of high-class research, if you are worthy of being infected with its spirit. We welcome members of the Agricultural Staffs of various Colonies. We hope that they benefit by their term here, and, in any event, you learn much from them as regards the conditions under which you will have to live and work.

I believe that, in the main, during the twentieth century, it is your type of work and its results that will justify some measure of alien guidance in the Tropics. Be not deceived; such guidance is on its trial today. Tested by the success that has attended our efforts to place scientific methods at the service of those who look to us for help, we British people have but moderate ground for satisfaction. We have concentrated on administration; we have lacked faith in what science has to give us.

I have talked recently to two friends, each holding a high official position, each recently returned from extensive Empire tours. Both of them have had unique opportunities of arriving at correct conclusions. They have both told me that, among much to justify legitimate pride, they blushed when they contrasted the economic development, based on scientific and medical research, in countries within the orbit of the British Empire, with the state of things obtaining under many foreign flags. I would like to cite another and different type of witness. I wonder if most of you have read a book I brought with me on the voyage out, and found most interesting reading. It is a collection of fugitive essays on scientific subjects, and has been given the title of "Possible Worlds." The author is Mr. J. B. S. Haldane, now of Cambridge University. The object that he has set before himself is, in his own words, that the average man should attempt to realize what is happening today in the Laboratories. In one brilliant essay—"Nationality and Research" is the name the author gives it—he tells us that in Europe two small nations, Holland and Denmark, lead in the output of scientific work per million inhabitants. He adds that they are, incidentally, two of the healthiest nations in Europe, and are both quite rich, though almost devoid of mineral wealth. This is because the are successfully employing biology; Denmark to her own Agriculture, Holland to the development of her Empire, which sets the example to the world in Tropical Agriculture and Hygiene.

Now, I am not content to read such criticism, especially since I entertain no doubt as to its truth. It is all very well to talk about British Administration and its excellence, the integrity of British justice, and the historic glory of the Privy Council. A hungry population intent on a much higher standard of living cannot exist on such things, indispensable preliminaries to social well-being though they are.

To listen to many eminent officials, one would almost think that political institutions were ends in themselves. I wrote to a distinguished tropical administrator the other day, and told him that I would yet find his subjects starving amid political perfection. I think he considered the criticism blasphemous.

But, even in much preoccupied Great Britain, there has been a stirring on the face of the waters, and an increasing comprehension of vital needs. More has been done in the Colonial Office during the last five years than in all its previous existence to make up the costly leeway, thanks, in the main, to the present Secretary of State and his enthusiastic and informed Parliamentary Secretary, Mr. Ormsby-Gore. A few years ago a strong Committee, presided over first by Lord Milner, and on his death by Lord Lovat, was set up to take stock of the situation, and the result was a remarkable document called the Lovat Report. If its recommendations can be carried into effect a great weakness and a great reproach will be removed.

I need not draw attention to the political and financial difficulties that will have to be surmounted before adoption is possible. One tangible result has already happened. Mr. Stockdale, known to many in Trinidad, and now, I am glad to say, a Governor of the College, is installed in the Colonial Office as Assistant Agricultural Adviser.

I do, however, state without fear of contradiction, that if the Report, as a whole, were adopted tomorrow, the Staff does not exist to man the various services and Research Institutions which are indicated as essential. It is to you and to your successors that we, in the main, look to fill this gap worthily. The whole tropical world is calling; no Christian Missionary, Jesuit, Moravian, Presbyterian, or Anglican, no Mohammedan Sheikh, no Buddhist Mahatma, ever has had a greater opportunity presented for work and sacrifice. And this is an appeal to you all, undergraduates and post-graduates alike.

And the particular fascination of the work is that it benefits not only the particular people among whom the worker's lot is cast, but the whole world fabric. Take a case in point. I have seen, during the last twenty years, arid lands south of Khartoum redeemed from barbarism and destructive fanaticism, caused in the main by degrading poverty. A contented population is now putting these lands to productive use, primarily to their own benefit, but in a scarcely less degree to that of the workers of Bolton or Lyons.

I will not, however, talk further on the direct possibilities of the work that is going on here. If you did not agree with me you would not be in Trinidad today.

Before I conclude, I am going to say one word on some of what I may term the extraneous difficulties that many of you will certainly encounter, especially in the later stages of your careers. When I talk on scientific problems and the application of the scientific method outside certain narrow limits, I walk by faith and not by sight. When I talk of political and administrative difficulties, I feel on surer ground. At all events, what I say is the outcome of thirty years' work and experience.

What I would urge you to remember is this, that if, in the various spheres of work to which you will shortly be transferred, you fail to keep alive and sensitive to the problems, administrative and political, industrial and agrarian, with which the East is seething, your work will be shorn of much of its possibilities of usefulness.

Have you ever asked yourself what are the ultimate objects that a College like this exists to serve ?

The late Lord Morley, in a magnificent address, which he gave some years ago to the students of Manchester University, suggested that a primary object of their University was "to weave the strands of knowledge into the web of social progress." If you accept that as an adequate definition, you cannot attain your maximum usefulness unless you provide yourselves with a working knowledge of the history, the political and

economic conditions, and, if possible, the language of the particular country in which you find yourself at work. Do not hug the illusion that the political and economic questionings which are troubling Africa and Asia are passing phenomena, or that you will be unaffected by them. The problems that today confront India and Ceylon will tomorrow face West Africa and the Sudan. My own view is that, in the near future, in many parts of the British Empire, great changes will be seen so far as the organization of scientific work is concerned. If the Lovat Report be adopted, a good deal else may in time follow. State Departments of Agriculture organized on bureaucratic lines may be transformed. The antiquated pension system may disappear in favour of something more elastic. Research and administration may in time be grouped round institutions which the Report proposes to set up, and conceivably round various great industrial organizations, such as the Empire Cotton Growing Corporation and the Rubber Growers' Association.

These institutions and organizations, though liberally supported by the State and the various Governments concerned, will be independent and free. State action will limit itself to co-ordinating effort. By some such means I would hope that the support and interest of the people among whom they work may be assured, with beneficial reactions in all directions Otherwise there is a real danger that scientific work may become identified with particular theories of political or racial ascendancy.

In that case, as changes take place in methods of government, the toll that politics takes of economics may be heavy indeed. This has already happened in Egypt, to the detriment of the material interests of the community. Of India I have scanty knowledge, but I have read the Linlithgow Report, and I know a little of the rise and, I fear, of the partial decline of the magnificent Imperial Department of Agriculture which Lord Curzon inaugurated.

All such recent events will repay your study. The recent Report on Ceylon is available, and the Report of the Simon Commission, when it appears, will be of supreme interest. Much, too, may be learned from a study of the policy followed by the Dutch in their magnificent Empire in the East, with its fifty millions of people.

In this connection, Mr. Ormsby-Gore's Report on his recent Far Eastern tour is well worth careful reading. The Hilton Young Report on conditions in East Africa has probably appeared by now.

Finally, it is unnecessary to remind you, the majority of whom are heirs to the traditions of British Universities, that research knows no colour bar, and that a distinctive feature of British University life has been the absence of nationalistic feeling.

What the contribution of the East may be in the future to the cause of research is (again to quote Mr. Haldane) veiled from our sight. Japan, with such work only in its first generation, is already up to the level of most European countries. China, under American guidance, is starting and India has fairly begun. It has already produced one of the outstanding mathematical figures of the twentieth century. And all over Africa and Asia foundations are being laid; in Beyrout, in Palestine, in Khartoum, in Ceylon, in Singapore, to take examples known to me.

While the first and paramount duty of each of you is to become a master of his own craft, a comprehensive understanding of the problems I have touched on is no less essential. Equipped intellectually and technically, as I have tried in these few words to indicate, you will be fitted to take part in the task on the success of which the material, moral, and spiritual progress of the human race in no small measure depends. That task is the justification of the West in the eyes of a questioning and awakening world.

THE TEA INDUSTRY IN JAVA.

(Continued from page 303.)

THE table below shows the rainfall at Buitenzorg, 885 feet above sea level, at Soekaboemi, the centre of the tea ara, situated at an altitude of 1,968 feet and at Malabar on the Pengalengan Plateau, about 5,000 feet up. For purposes of comparison, the rainfall at Kandy, one of the tea centres of Ceylon, and at Tocklai which is representative of the Assam Valley, together with that of Siantar, the centre of the largest tea area in Sumatra are also given.

	Buitenzorg	Soekaboemi	Pengalengan Plateau.	Siantar, Sumatra.	Kandy, Ceylon.	Tocklai, Assam.
Elevation	885 ft.	1,968 ft.	5,000 ft.	1,500 ft.	1,654 ft.	290 ft.
	ins.	ins.	ins.	ins.	ins.	ins.
January	17·6	24·7	13·9	11·1	5·2	1·0
February	15·9	11·2	12·5	7·2	2·2	1·4
March	16·6	15·1	13·2	8·9	3·9	3·6
April	16·2	16·1	10·9	8·7	6·8	7·9
May	14·9	10·4	6·6	12·0	5·4	9·7
June	11·1	6·5	4·4	6·7	9·6	12·4
July	10·2	3·9	2·4	6·7	7·5	17·0
August	8·8	3·8	2·6	9·6	5·7	13·0
September	13·5	4·0	4·2	13·7	5·9	10·1
October	16·7	9·1	7·7	16·7	11·8	4·5
November	15·6	13·8	10·7	8·8	10·6	0·9
December	14·6	16·4	13·3	9·8	9·1	0·4
Total	171·7	135·0	102·4	119·6	83·8	81·8

Conditions at Tocklai are indicative of those in Northern India where the rainfall shows a regular increase and decrease with the advance and retreat of the south-west Monsoon. At Kandy, the advance of the south-west Monsoon is apparent somewhat earlier than in Northern India. The heavy rainfall in October, November and December is brought by the north-east Monsoon which, having blown dry from Central Asia, has picked up moisture crossing the Bay of Bengal and is thus able to deposit rain on the eastern side of Ceylon. Kandy in its central position receives copious rain from both Monsoons. Conditions in Sumatra are somewhat similar to those in Ceylon.

In spite of the fact that Java, like Ceylon and Sumatra, is surrounded by sea, it actually gets only one wet season over the greater part of the island, although the dry season is only dry by comparison.

Most of the rain comes from a north-westerly direction for the west or wet Monsoon has travelled farther over the sea than the east or dry Monsoon. Also, during the wet Monsoon, the vertical factor in the air movement is an ascending one and the opposite of the east Monsoon (decending) both factors tending to accentuate the particular characteristic of the season.

In the east of Java, drought may be severe and this is one of the factors accounting for the fact that tea is practically confined to west Java,

In North-East India, with a five-month drought period, it would appear at first sight that conditions were much harder than in Java. Conditions are, however, not comparable, for temperatures are much lower in India during the dry period than in Java where, as in Ceylon and Sumatra, a steady high average is maintained through the year, with a correspondingly rapid rate of evaporation.

The mean temperatures in January and July in Java and other tea countries are shown below.

	January °F.	July °F.
Buitenzorg	75	77
Bandoeng	72	72
Pengalengan	62	62
Siantar (Sumatra)	71	73
Kandy (Ceylon)	73	75
Nuwara Eliya (Ceylon) ...	57	59
Tocklai (Assam)	60	83

Frosts occur on the Pengalengan Plateau and, in the lowest basins of this undulating area, damage is done to tea when the temperature falls below 30°F. Frost is registered in July, August and September and October.

Although the crop is gathered in Java all the year round, it is not distributed evenly through the year. The heavy cropping period begins in November and continues till April, coinciding with the wet season. During the drier part of the year less crop is made.

Meteorological observations are taken very fully on Java estates where, in addition to the simpler instruments like thermometers and rain gauges, sunshine recorders and self-recording hygrometers and thermometers are also used. Some estates have anemometers installed. The observations are sent to the Meteorological Station in Batavia with the result that a very complete and comprehensive mass of data is available.

THE TEA SOILS OF JAVA.

The soils of the greater part of Java consist of the weathered products of eruptive rocks, and most of the tea soils are derived from the weathering *in situ* of volcanic ash, sand and lava.

The oldest rocks, granites and shales, which make up the foundation of the island, are very little seen on the surface because they were covered up during the tertiary period with volcanic material. The formations of the cretaceous period are also unimportant with regard to the present state of the island. The volcanic deposits of the tertiary and later periods form the greater part of the present surface. During later geological times, the eocene and miocene periods, sandstones, conglomerates and breccias of volcanic material were formed. In the later miocene period clay, marls and limestones were formed.

Andesite and basalt give rise to about 75 per cent. of the soils in Java; the older eruptive rocks giving rise to soils are diabase and gabbro. These are all volcanic rocks of the basic type, by virtue of the fact that they contain not more than 60 per cent. silicic acid and the balance of basic oxides of lime, magnesia, soda, iron and alumina.

These basic rocks differ from the acid rocks composing a large part of the Himalayas in that they are richer in substances giving rise to plant foods. The Himalayan rocks give rise to the Darjeeling and Dooars soils. Most of the Assam tea soils are new alluvia, consisting of as much as 90 per cent. in some cases of insoluble matter, mainly quartz.

In order to compare the Java soils with those of North-East India, some suitable method of classification is necessary. Such a classification is admittedly difficult. Thus a classification based on geological origin will not serve in regions where the climate differs widely, for the same rock may give rise to totally different soils according to climate and the degree to which the disintegrating processes have proceeded.

Classification on a purely physical basis is scarcely more satisfactory since, as such, it may involve the grouping together of soils otherwise absolutely unrelated. Such a classification is however of practical importance and will be dealt with later.

The broadest classification is related to the mode of operation or rock disintegration and rests ultimately on a climatological basis, since the process of rock degradation is controlled by climatic factors. The original material may differ, but the constant working of a given set of conditions tends to produce the same product. On this climatic basis, the soils of Java are classed as lateritic.

The process of laterisation is not completely understood but it depends on the leaching out, by alkaline waters, of the silicic acid from the weathering complex. The most favourable conditions for this occur in the humid tropics and, in extreme cases, the surface soil consists almost entirely of hydrated iron and aluminium oxides.

In Java where the temperature changes according to the altitude and the rainfall varies widely, different stages of laterisation are seen. Thus on the hot sunny lowlands where the rainfall is so persistent that the general water movement is down through the soil, typical red laterite is formed. In the higher altitudes where temperatures are lower, the sky often cloudy and the bacterial activity of the soil accordingly slowed up, somewhat less well-developed types of laterite occur.

In the high mountains of Java there is a layer of white decomposing rock under the humus soil. This layer is bleached by the humic acids as they are washed down from the upper layers, carrying with them the salts of iron and alumina to lower layers. This is the reverse process of laterisation and is similar to the disintegrating process noticed going on in some parts of the hills bordering the Assam Valley.

In other parts of Java where conditions of intensive percolation of water through, and evaporation of water from, the soil occur alternately according to the seasonal rainfall, black and brownish soils occur. These conditions correspond generally with ours in North-East India where the process of turning brown is hastened by aeration. The general tendency in our soils is towards laterisation, although the rate of change is much slower than in Java.

One point worthy of note is that lateritic clays are not sticky as are ordinary clays in which the fine particles are composed, not of the hydrated oxides of iron and alumina, but of complexes of alumina and silica.

Leaving now the geology and classification of Java soils it is of interest to examine them from the practical point of view and to compare them, with regard to their content of plant food, with the tea soils in North-East India. The Dooars soils are comparable in richness to those in Java, but the average Assam soil is much poorer.

The best Java soils contain 1 per cent. nitrogen and the average about 0·35 per cent. The average in North-East India is about 0·1 per cent. and the best soils of the Red Bank in the Dooars may contain as much as 0·2 per cent. nitrogen. The nitrogen in the alkali soluble humus or *matière noire* in Java is about the same, or somewhat greater, than the total nitrogen in Assam. With a nitrogen content as great as is shown in Java soils we should rarely, in India, advise the use of nitrogenous manures.

On the Pengalengan Plateau the soils show an average content of organic matter of about 10 per cent. with an average alkali soluble humus content of about 3 per cent. These values compare with the best of the Red Bank soils in the Dooars. The best Java soils show about 50 per cent. of the organic matter as *matière noire.*

The potash content of the Java soils is very high, so high that it is not a factor to be considered, and the application of potash manures has been found to give no beneficial results.

The phosphoric acid is considered poor in the tea areas in West Java, although a wide variation occurs and, on this account, an average value is robbed of its significance. In the tea soils of North-East India, the average total phosphoric acid varies from about 0·05 to 0·15 per cent. and the available is about 0·01 per cent. or less. The values in Java are generally smaller than these.

The total lime also shows a wide variation in Java as in India and may be as little as 0·1 per cent. or as great as 1 per cent. on different soils. The average value for total lime in Assam is about 0·1 per cent. and on the Red Bank in the Dooars about 0·4 per cent.

The Java tea soils are slightly acid. A soil with a pH value of 6·8 grows good tea but the bushes on such a soil are subject to the root disease, *Rosellina arcuata.* Many Java soils show pH values circa 5·5. The pH values of the tea soils in India vary considerably, but 5·5 is a fair average. Soils showing values of about 6 or above are generally bad for tea in North-East India.

The mechanical analyses of the Java tea soils show them to vary over an extremely wide range from the lightest of sands to very heavy clays. The very young volcanic soils are very sandy, and, as a rule, contain only a small percentage of clay. The young volcanic soils have had time to weather and may be classed as fine sands or as silts, although many of them are as light as the very young volcanic soils. As the age of the soil increases, the percentage of the finer soil particles increases and the older soils, which have come from the younger ones, show clay fractions often as great as 60 or 70 per cent. The geologically old soils contain still more clay than this last type.

The Pengalengan soils resemble physically some of the volcanic soils and are silt types. The striking characteristic of these soils is their richness in organic matter.

In North-East India where soils have been partly laid down by water and partly weathered, the variation in soil types is much greater than in Java.

The table below shows the various soil types in Java with the fractions given after Mohr's method of mechanical analysis.

	Sand %				Silt %					Clay %
Soil Type	Very coarse	Coarse	Medium	Fine	Very fine	Sandy	Coarse	Medium	Fine	
Very young volcanic	47	24	15	1	1	2	2	3	2	2
Young volcanic	7	9	23	22	9	11	8	6	3	2
Pengalengan	2	4	20	24	15	16	8	5	2	4
Old soils	0	0	1	2	1	3	4	12	10	63

These values cannot be exactly converted into figures comparable with analyses made on North-East India tea soils by Hall's method. A rough

comparison however may be made from the following table in which the values from the first table are indicated, as nearly as possible, according to Hall's limits for the various fractions. The figures denote percentages.

Soil Type	Gravel	Coarse sand	Fine sand	Silt	Fine silt	Clay
Very young volcanic	47	37	2	2	3	4
Young volcanic	7	32	31	11	14	5
Pengalengan	2	24	39	16	13	6
Old soils	nil	1	3	3	16	73

First, it is necessary to remark that very few of the North-East India tea soils, except in the Dooars and on the North Bank in Assam, contain gravel. The very young and young volcanic soils resemble the Mal sands of the Dooars mechanically. The Pengalengan soils are similar to the sandy silts of the Eastern Dooars, the North Bank of Assam and to some of the soils on the Doom Dooma Bank. We have no soils under tea approaching the old soils of Java in heaviness. Some of our heaviest soils occur in the Sibsagar district of Assam, and contain as much as 50 per cent. clay of a yellow colour and sticky nature.

PLANTING, PRUNING AND PLUCKING.

About three-quarters of the tea in Java is situated on slopes and steep hills and most of the tea is planted at altitudes above 1,000 feet. On account of the irregularity of the land and because of the type of plucking, the extensive, even sheets of tea which are a feature of North-East India are not seen. The Java tea areas resemble in appearance those of Ceylon and South India.

The tea plant in Java seeds all the year round, but most freely in November, December and January, and gives a total seed crop about the same as in India. Most of the planting is done between the beginning of the rains and the end of February and the seed not used locally is exported to Sumatra and Ceylon.

The seeds are planted about six inches apart in nurseries and overhead shading, supported by bamboos, is advocated. At about fourteen months the young plant is cut to about six inches, the soil loosened and the "stump" removed and replanted in a manner similar to that employed in Ceylon and South India. Seed is often sown at stake, shaded with boga medeloa (*Tephrosia candida*) planted in rows to help the formation of terraces. Transplanting with a clod is seldom practised.

Tea used to be planted in rows with the bushes three feet apart, triangular to the bushes in the next row planted at a perpendicular distance of four feet from the first. It is now suggested that the rows shall be six feet apart in order to leave a space for green cropping.

In Sumatra where opening out is at present carried on all the year round, several methods of transplanting are employed. Seed is planted at stake and by this method 50-60 per cent. of the plants live and thrive. Two-month-old plants are also used and are transplanted without earth. At this stage the seedling is still living on the cotyledons, and the shock of transplanting is not serious. From 80-90 per cent. of such plants are successful but the drawback to this method is that selection is difficult. With somewhat older plants, "stump" planting gives 70 per cent. successes, whilst clod planting with still older plants gives 90 per cent. successes.

The pruning of tea in Java differs essentially from that in North-East India and resembles that practised in Ceylon and South India. Indeed there is a close resemblance between methods throughout the treatment of the

bush and the manufacture of tea in these three areas, owing largely to similar climatic conditions.

Pruning in Java is not done so well nor so carefully as in Assam although it is usually better than that in the Dooars and the Surma Valley. When a "stump" cut at six inches in the nursery has been transplanted about two years it is cut across at about 20 inches, a little lower in the centre than at the sides. In many cases this cutting is accompanied by centering. The bush is the pruned up, on an average every two years for the next ten years or so, i.e., five times, after which it is taken down again to about 20 inches.

On some gardens a "skiff" is given to the bush in place of a light prune and, although this gives leaf temporarily, the ultimate result of such treatment is detrimental to the bush.

One of the most important factors to be considered when discussing pruning methods is climate. Java has no dry, cold weather when the bushes stop flushing, and plucking continues steadily for two or three years before the bush is pruned. On account of the climate, old wood can be cut without much snag formation and the cuts heal over well, owing to the light plucking. It is unsafe to attempt to prune in North-East India on the lines adopted in these regions of continual rain and steady high humidity. Tea left unpruned in North-East India becomes diseased and looks very different at the end of two years from the healthy bushes seen in either Java or Ceylon. Even if our bushes were as lightly plucked as in these countries it is doubtful whether, after the strain due to the drought, the bush would enter the second season so well equipped as a similar bush in Java. Apart from labour considerations, alternate year pruning does not pay in the plains districts of North-East India. On the healthiest of tea it is however occasionally profitable (once in three years, perhaps) to leave the bushes unpruned.

After ordinary pruning in Java, the bush is out of commission for three months more or less, according to the age of the wood cut. The first plucking is made above three leaves, the next above two leaves and then above one leaf for all successive pluckings. After heavy pruning, plucking is made at a height of about 28 inches.

By somewhat closer plucking than that described above and by plucking to the *janum* or "fish leaf" in the third year, the height of the bush can be kept down so that pruning can be put off for another year, although after such a period the plant takes longer to recover than if it had been pruned at the end of the second year.

Three leaves and a bud are plucked and smaller shoots than this are considered to be immature. The plucking period is 10 or 12 days and sometimes up to 16 days. With the leaving of a leaf at each plucking the bushes get steadily taller till at pruning time they may be seven feet high. With these high bushes the thin supple branches are bent over to be plucked.

Consistent plucking to the *janum* at a height of about 30 inches has been tried in Java but this brings on red rust and mosquito blight. Such close plucking in Ceylon also seriously harms the bush and, indeed, in North-East India, *janum* plucking on a six-inch growth with a top pruned bush can only be practised year after year on strong tea. Judging also by experience in our own districts it seems that coarse plucking to the *janum* is much harder on the bush than fine plucking consisting of two leaves and a bud to the *janum*. In the Dooars and the Surma Valley where three leaves and a bud are generally taken, *janum* plucking is not practised until well on in season.

Although the actual plucking is coarser in Java than in India, the plucking is so long, *i.e.*, always above a leaf, that the crop gathered is not as large as might be expected. On account of the high bushes and difficulty in moving amongst them, the leaf is collected in cloths and not in baskets.

MANURING AND CULTIVATION.

The practice of using artificial fertilisers is increasing in Java, but has by no means reached the same stage as in India. Experiments show that nitrogenous and phosphatic manures improve the crop but potash does little in this respect. This corresponds with our experience of manuring red soils in North-East India and is the same as has been observed in Ceylon. Although nitrogenous manures alone give a crop increase, they are best added with phosphatic manures.

Manures are applied at rates given as so much per bush, and the following suggestions are made by the Theeproefstation : per bush, 10 gms. sulphate of ammonia with or without superphosphate or 20-30 gms. urea or 75-100 gms. whale fish guano or 75-100 gms. animal meal. These manures are added every other year.

The amount of manure added by 30 gms. sulphate of ammonia per bush according to Java planting, where about 3,400 bushes go to the acre, works out to 220 lb. per acre or an equivalent of about 45 lb. of nitrogen. The double dose adds, of course, 90 lb. nitrogen. These figures may be compared with the practice in North-East India of adding about 30 lb. nitrogen each year.

The manures are broadcast with a hand fork, preferably a short time before the rains or after pruning. If chemicals are given one time, oilcake may be given the next. The general idea in manuring is first to get a good, humus-rich soil, producing a good bush, which is then manured, since it pays best to manure good tea. It is suggested that poor tea should be rested under *Albizzia moluccana* (Ceylon Sau) in order to strengthen it, in preference to being manured and plucked.

Cattle manure is not used to any extent and, indeed, in a country where an effort is made to control weed growth, the use of this manure introduces a serious difficulty, because it carries with it the seed of weeds.

Green manuring by means of ground crops and shade trees is widely practised in Java tea gardens, and it is common for the whole garden to be under a green crop of some kind. The older the garden and the closer the tea the more necessary is it to supply the organic matter from shade trees.

It has been observed that different green crops are able to tolerate different ranges of soil acidity and the continued application of sulphate of ammonia seriously affects the growth of some of the crops, since the manure tends to increase soil acidity.

Of shade trees grown, *Albizzia moluccana* is the best and most popular. The dadap (*Erythrina indica*) and *Derris robusta* are also common. Shade trees are closely planted, pollarded at about 12 feet, and later on lopped and the loppings left as a mulch or buried. It is common to leave the shade up in the dry season and to lop it in the rains.

Of the ground green crops, *Tephrosia candida* (boga medeloa), *Crotalaria usaramoensis, C. anagyroides, Indigofera endecaphylla Colopogonium mucunoides, Vigna oligosperma, V. Hosei* and *Leuceana glauca* are at present most used. The last which has deep roots is much grown on hill slopes. *Clitoria cajanifolia,* once very popular, is not widely used now.

The method of using green crops in Java is quite different from that in North-East India on account of the different climate. In the latter country one of our problems in the dry months is the conservation of soil

moisture and a clean soil, mulched by hoeing, is necessary to that end. In Java the green crop is left up as long as possible and then cut, and allowed to grow again. The cut crop is left on the soil as a mulch to keep off the sun.

Some years ago the tea estates in Java practised clean weeding, as is still the procedure in Ceylon. This process has now been stopped and either selective weeding is used, or the soil is covered with a low growing crop if the bushes themselves are not big enough to keep the weeds in some sort of control.

At present, the consensus of opinion is against frequent soil disturbance, much as is the trend of ideas in North-East India, although control of weeds is necessary. Deep cultivation in the form of deep hoeing and trenching has also ceased to be as necessary as it was when frequent light hoeing was the rule. Another reason why the amount of trenching is limited is that it leads to the spread of *Diplodia* and prunings are left in lines but not usually buried. *Diplodia* (known as *Thyridaria tarda* in North-East India) is controlled by the addition of lime to the trenches.

Drains are not as a rule necessary in Java because the soil is so porous. The loss of soil by wash is reduced in areas where the tea is small, by means of silt pits, although after weeds have been grown selectively this practice is not continued. Soil wash is also reduced by hedges of green crops.

The hill slopes on tea estates are perfectly terraced, for the natives themselves are masters of this practice in their own cultivation. Sometimes the hill side is contour planted with a green crop before planting, so that the terraces form naturally.

PESTS AND BLIGHTS.

Most of the fungi which attack tea in North-East India are known in Java, although they operate with different degrees of virulence.

Of the root diseases, *Ustulina zonata* (charcoal stump rot) is common on all soils. *Rosellinia arcuata* (black root rot) occurs on soils which are neutral or only faintly acid. *Fomes lamaoensis* (brown root rot) occurs sometimes, but *Sphaerostilbe repens* (violet root rot) does not attack tea, although it is common on rubber and green crops. *Diplodia* (die-back) also occurs.

So far as leaf and stem diseases are concerned, these blights are much less prevalent than in North-East India, where, at the end of the season, the leaves and small shoots are often a mass of blights, especially if the plucking has been hard. In Java, brown blight and grey blight are common but blister blight and copper blight are not known. Thread blights, *Nectria* and *Corticium* are known, but are not common. Red rust is a very serious blight and often completely cripples weak or debilitated tea, especially after an attack of mosquito blight.

Septobasidium rubiginosum is very serious and may kill out strong plants, both tea and green crops. *Septobasidium* spp. are found in North-East India, parasitic on scale insects but, so far, on only two occasions has the fungus been observed to be parasitic on the tea plant. The attack of *Septobasidium* in Java has increased during the past few years and has spread from dadap and *Crotalaria anagyroides*. An attack by this fungus may be followed by red rust.

The spraying of tea for blights is not practised in Java and the formation of the land is all against the carrying of materials for intensive spraying. For the most serious leaf and stem disease, *i.e.*, red rust, the bush is given a rest from plucking. Generous treatment is regarded as the best safeguard against fungus attack.

The most serious tea pest in Java is *Helopeltis* (the tea mosquito). The pink mite is sometimes serious but red spider is not so common as in India. Thrips and other pests occur, but are not serious. Green fly is not known.

Much interesting and useful work has been done on mosquito blight in Java. The species of *Helopeltis* known in Java are *H. Antonii* Sign., *H. Theivora,* Waterh., *H. Cuneatus* Dist. and *H. Cinchonae* Mann. *H. Theivora,* the species doing damage in North-East India, is practically harmless in Java where *H. Antonii* takes the greatest toll of the tea bush. At altitudes above 4,000 feet a different variety of *H. Antonii* is found which prefers Cinchona to tea. *H. Cinchonae* has been shown to attack tea.

According to observations it appears that the mosquito punctures the veins of the leaf and that immune bushes are harder in the veins than others. The mosquito cannot stand exposure to bright sunlight while dense shade encourages the pest. However, since the foliage of the bush itself provides sufficient shade for the insect, the cutting down of shade trees has not been practised in Java. The removal of shade may, however, have an indirect influence on the mosquito, in that bushes growing in the sun have a somewhat different composition from those growing in the shade. It has been observed in Assam that the removal of shade trees does, at times, diminish the intensity of mosquito attack.

Many methods of combating mosquito have been tried, including hard plucking, special pruning, hand catching, fumigation and spraying, with varying results, generally failure.

A few years ago the entomologist of the Theeproefstation discovered a parasite of the tea mosquito, *Euphorus helopeltidis*. The eggs of the parasite are laid on the first larval stage of the mosquito and later the cocoon of the parasite goes to the soil. When the mosquito is hand caught, samples are sent to the Theeproefstation for examination and if more than 50 per cent. of those in the larval stage are infected with the parasite, it is advised that hand catching be stopped. By this means the reproduction of the parasite is encouraged. It has been observed that shade encourages the parasite. A parasite of *Euphorus helopeltidis* has also been discovered but it is rare. In North-East India a parasitic mermithid worm has also been observed but its ravages on the tea mosquito are not serious enough to warrant any hope that it may control the pest.

On Tjiboengoer Tea Estate interesting experiments on the control of mosquito by pruning have been made. Briefly, the treatment consists in pruning alternate rows of tea in a block every two years. Only good areas of sound tea, from which the worst effects of the blight have been eliminated by the previous good treatment, may be expected to respond to alternate row pruning.

This type of pruning has been tried on other estates, sometimes with success and sometimes failure. The reason why bushes pruned in this manner should be able to throw off the blight has not been explained, but it may be due partly to the fact that the surroundings are rendered less favourable to the insect, and partly to the fact that the area as a whole benefits by having part of the bushes exposed every year to the sunlight at pruning time.

Mosquito in Java attacks at any time, but generally in February and March, at the end of the wet season. The attack is aggravated by red rust which often completely wrecks the frame of the bush just as the subsequent attack of brown blight in India often finishes off the devastation started by the mosquito. In Java it is observed that the weaker bushes have the axillary as well as the terminal buds attacked by mosquito.

So far as the writer's observations were concerned, the ravages of the pest in Java are not so serious as those experienced either in the Dooars or the Surma Valley. True, the crop in Java may fall to *nil* when the attack develops, just as it does in North-East India, but the bushes with their full healthy foliage do not seem so badly hit as those in India where the plucking is harder. Hard plucking has proved fatal in Java and the best general treatment for tea liable to mosquito attack is generous manuring and light plucking.

TEA MANUFACTURE.

Power and Machinery.—The tea factories in Java are run largely on hydro-electric power, and the hilly nature of the country and steady water supply are made use of to the fullest extent in this direction. In one or two cases tea is dried by air electrically heated.

The tea machinery used, like rollers and driers, is British, as are most of the sorting machines. Individual machines are generally worked by separate motors and the absence of shafting and belting is a great advantage.

Withering.—In Java, leaf is withered in lofts into which hot air passes after being bulked in a central chamber. The loft and fan arrangement is similar to that in Ceylon. Wire racks are usually employed.

The spreading of the leaf is much thicker in Java than in either Ceylon or India. Thus the Experimental Station at Buitenzorg advises that one kilo of leaf be spread on a square metre, when the racks are of wire mesh. This is about 2¼ lb. leaf to 10 square feet just about twice the thickness suggested in India. On boards or hessian, about half a kilo and on plaited bamboo, three-quarters of a kilo of leaf per square metre is suggested.

In Java, as in India, the value of withering the leaf at low temperatures is recognised and 82°F. is the ideal suggested for the loft. A withering period of about 18 hours is advised and a loft well ventilated with fresh air.

The leaf is considered to be physically withered when it has lost from 10 to 40 per cent. of its original weight according to the initial moisture content of the leaf. Thus it is advised that leaf containing 80 per cent. moisture when it is plucked should dry till it has lost 40 per cent. of its weight. On an average, 100 lb. of leaf are dried to about 60-65 lb.

In India, during the Monsoon, when the leaf on the bush contains about 77 per cent. moisture and the air temperature averages 83°F., it is customary to dry 100 lb. leaf to about 70 lb. At the beginning and end of the season, although the fresh leaf is drier, the temperature is lower, and a fuller physical wither is given. In Ceylon 100 lb. leaf are dried to about 55 lb. in the "high grown" districts where temperatures are low.

The great difference in the degree of the physical wither in the three countries is due largely to the difference in temperature, this factor being a controlling one in determining the rate of the chemical wither. In many of the low-lying Java estates, temperatures are only slightly lower than those of Assam, registered during the Monsoon. However the leaf, grown under thick shade, is said to contain a greater moisture percentage than that found in India and this factor necessitates a fuller physical wither than is customary in India.

In the factories on the Pengalengan Plateau, at an altitude of about 5,000 feet, withering machines invented by Mr. Bosscha, of Malabar Tea Estate, are used. The machine consists essentially of an octagonal cage about 10 feet long, each side of the octagon being about 20 inches long, with a central arrangement for blowing in hot air.

Leaf, after being physically well withered on the racks, is placed in the withering machine, one face of which acts as a door. Enough to serve one roller constitutes a charge and the leaf is then submitted to a hot air

blast at about 120°F. for about 30 minutes, whilst the machine rotates at about 35 revolutions per minute. At the end of half an hour the door of the machine is opened and, as the machine continues to revolve, the leaf is flung far out and thus cooled. The leaf loses 3 to 4 per cent. moisture during the process, becomes limp and takes on a reddish brown colour and a strong smell of apples. It is claimed that these machines make the wither regular and reduce the time of fermentation from six or seven hours to two or three hours. Only one Bosscha Withering Machine is in use in North-East India, in a garden in the Surma Valley. Here it has been found that the best results are obtained when the machine makes about 15 revolutions per minute and, by its use, the fermentation time is reduced from three hours to three-quarters of an hour. It has been noticed that the amount of red stalk in teas thus treated is less than with untreated leaf. It will be understood that the Bosscha Machine deals with the chemical rather than physical processes of withering.

Rolling.—In Java, the rollers revolve slowly, making only about 40-50 revolutions per minute. The second roll is sometimes carried out in rollers revolving somewhat faster than in the first roll, the idea being that slow rollng preserves the "tip."

The rolling period, on the average, is not nearly so long as in Ceylon, where it may last three hours for the fine leaf, nor is the leaf submitted to so many revolutions as in India where the rollers make 60 or even 70 revolutions per minute.

Fermentation.—In most fermenting rooms some modern form of humidification is used. Most of the humidifiers are of the scent-spray type in which cooling and humidification of the air are carried on at the same time. A relative humidity of 95 per cent. is aimed at, since higher values than this result in deposition of moisture if a fall of temperature occurs. The need for a plentiful supply of fresh air in the fermenting room is recognised. Leaf is thinly spread for fermentation and in the gardens of high elevation and low temperatures the fermenting room is sometimes warmed.

Firing.—Firing is usually carried out in one process in about 15-20 minutes, at temperatures varying from 175°F. to 212°F., although the lower temperatures are preferred.

Wood and, in a few cases, oil are used for firing. At Malabar Estate the firing is done electrically, and it was found that, during the earlier trials, the power consumed by a large E.C.P. machine was as much as 160 kilowatts. After the stove of the dryer had been rebuilt and the leaks in the body of the machine stopped to avoid all unnecessary air loss, the required power was then reduced to about 110 kilowatts.

In Java the firing machines are lagged or insulated by plates of itanit, eboloiet or makinit, leaving about a foot of air round the stove and the air ducts. These insulating materials are of the patent asbestos-compound type, the first kind being a thin sheet and the other two thicker, and able to stand more rough usage. The insulating sheets are built on light iron frames in a manner which makes it easy to remove them for cleaning or examining the machine.

By insulation, the fuel consumption for firing has been reduced by as much as 40 per cent. on many gardens. Taking a conservative estimate of the economy at 25 per cent. of the fuel comsumption, the annual saving in North-East India would be about Rs. 10 lakhs reckoning on a crop of 320 millions, and assuming that it takes one maund of coal costing one rupee to fire a maund of tea. The cost of insulation is about half the saving in fuel cost during one year.

All stoking of the dryers is done outside the factory and this precaution against dust and untidiness is in keeping with the general cleanliness of the Dutch tea factories.

Sorting.—The sorting rooms are kept scrupulously clean and free from dust. Above each sorting machine are air ducts which remove fluff and keep the atmosphere clear. The result of this is that the Java teas are generally cleaner than Indian teas, a necessity to teas selling largely on appearance.

Most of the sorters used in India are seen in Java. One interesting sorting machine is made by the firm of Assendelft de Coningh of Soekaboemi, combining the rotary sieve for broken grades and the reciprocating sieve for leaf grades, of which Java makes a big percentage.

Java teas are packed containing 7-8 per cent. moisture. This percentage, as the result of many experiments, is considered to be the best. A somewhat lower figure, *viz.*, 6 per cent., is aimed at in India. This percentage is considered to be a safe one if teas are to be kept for any length of time without risk of "going off."

On some Java estates, the moisture is estimated by means of a simple apparatus whereby a weighed amount of tea is warmed with xylol. This substance distils together with moisture from the tea, and both are condensed into a small measuring cylinder in which the amount of water, sinking to the bottom as a separate layer, is read off. The estimation is somewhat simpler than that employed on gardens in Assam since it involves only one weighment.

General.—The tea factories in Java are finer than those in India so far as arrangement and order are concerned. The freedom from dust in the sorting room and the general cleanliness in the firing and rolling rooms are matters for remark. The methods employed in manufacture resemble those of Ceylon, so far as fulness of wither, slow rolling and firing by a single process are concerned.

JAVA TEAS.

Java teas are well made and clean, and the leaf is black with plenty of twist as opposed to the greyish or brownish flaky teas of North-East India. The grades are similar to those in India, although as much as 60 per cent. B.O.P. may be made.

Java teas lack flavour and the liquors are coloury but soft, lacking in strength. There is little "tip." The quality period in Java is from mid June to mid October, the dry season, when a little flavour is noticed. For the rest of the year the teas are common and plain. Even the high-grown teas show little flavour although they are brighter and brisker than the low grown. The poorest months are from November to April, the wet period.

The Java tea prices are lower than those of India and Ceylon and it is instructive to consider some of the reasons accounting for these differences.

First, the climate is against true quality periods such as we get in India, for there is no season comparable with the cool, dry spring and autumn experienced in North-East India when leaf grows slowly and a good natural wither is obtainable.

The method of plucking in Java is not conducive to quality for, in addition to the leaf being coarse, the plucking is long. In Assam it is found that, for quality, the leaf must be plucked not only fine but also close, and our best teas come from places where the plucking is to the *janum* or "fish leaf."

The manufacture of *kampong blad* (village leaf) also lowers the average quality of Java tea. In the Kandy area of Ceylon the quality of the tea is similarly reduced by the manufacture of village leaf. On some gardens *kampong blad* is so coarse that it is rolled lightly for a few minutes and then sifted in a coarse rotary sieve to remove the very big, hard leaves. All the rough tea fibre and much of the stalk is sold as Bohea and the amount of this grade may be as much as 10 per cent. but usually varies between 3 and 6 per cent.

In addition to the influence of the leaf on the quality of the tea, there is also that of the method of manufacture. Java leaf does, from North-East India standards, appear to be chemically overwithered. The result of this is a tea with a soft liquor.

It is usual in Java for tea planters to say that quality is not *in* the soil or the district, just as planters do in the poor quality districts in India. So far as North-East India is concerned, it has been shown that good teas, above the average price, can be made in any district and on any soil provided the plucking is close, fine and regular, but whether it is sound to make good teas by this means at the expense of crop and labour is an economic and not a scientific question.

TEA GROWING IN RUSSIAN TRANS-CAUCASUS.*

DOWN along the eastern coast of the Black Sea, north of Turkey and south of the Caucasus Mountains, lies tea cultivation's farthest north and the Union of Socialist Soviet Republic's farthest south. Here in the district about the seaport town of Batoum, in latitude 41° 30' to 42° 30' N. and longitude 42°W., the climate is sub-tropical and the tea bush thrives. Tropical plants and palms grow in abundance in this, the Riviera of Russia.

The long slopes of land on which tea is grown are protected from the cold blasts usually associated with thoughts of Russia by the mountains to the north. From the west, moisture-laden breezes from the Black Sea make the climate closely correspond to that of other tea-growing countries. The average winter temperature for Batoum is 44°F., and the average annual rainfall is 92 inches.

THE START OF TEA GROWING IN RUSSIA.

The history of tea cultivation in Russia dates back to 1847. In that year tea was first planted experimentally in the botanic gardens of Sukhum on the Black Sea at the instance of the Viceroy of the Caucasus, Vorontzoff. Indeed, some of the bushes planted by Vorontzoff are still alive and healthy. Others followed the Viceroy's lead, and further outdoor experiments were made until successful tea production was demonstrated. A pioneer in this movement was Col. A. Solovtzorff who, in 1884, planted about five and a half acres of tea with seedlings brought from China.

Perhaps the best known protagonist of tea planting in Russia was the late Mr. C. S. Popoff, president of the once famous tea trading firm of Popoff Freres. Mr. Popoff purchased three estates on the eastern shore of the Black Sea near Batoum and set out nurseries. In 1893 he planted 385 acres with seedlings from his own nurseries and others brought from China. Later on, he successfully planted seedlings grown from seeds brought from India and Ceylon by M. Klingen and Professor Krasnoff. Mr. Popoff imported fifteen Chinese foremen and labourers to work the estates and teach the natives and installed teamaking machinery brought from England.

Following Mr. Popoff's lead the management of the Crown lands at Chakva, fifteen miles from Batoum, prepared and planted 600 acres of the Crown estate in tea. In 1900 the Ministry of Agriculture established a tea experimental station which later supplied local landowners with tea seedlings free of charge. As a result of this promotional measure, great interest was aroused and many of the existing plantations were started at that time. In 1905 the area under tea had been increased to approximately 1,100 acres on 39 estates, and by 1913, the last pre-war year, there were 2,300 acres on a total of 146 estates.

* From *The Tea and Coffee Trade Journal* of November, 1928.

Meanwhile, in 1900 some twenty-five experimental tea fields were planted in the Kutais area, an interior district north of Batoum. After six years of experience in these fields, many private landowners in Mingrelia and Gouria made small plantations averaging from one and a half to two acres each. In 1913-14 many peasants began to cultivate small patches of land leased from the villages.

THE EFFECT OF THE WORLD WAR.

Mr. N. J. Sherville, in a letter to *The Times of Ceylon* in 1922, recalls that just previous to the World War "there were the following factories for the manufacture of tea in Trans-Caucasus: Batoum district—the Tzar's own estates, Mr. C. S. Popoff's estates, the Ministry of Agriculture's estates, Mr. Sinitzin's estates, and Mr. Diadusha's estates; Kutais district—Prince Nakashidza's estates." Mr. Sherville also gave the following figures showing the number of estates, their acreage, and the manufactured tea output from 1905 through 1913 in the Batoum district:—

	Estates	Acres cultivated	Manufactured tea in pounds
1905	39	1,100	144,000
1906	51	1,200	103,000
1907	64	1,300	61,000
1908	91	1,310	137,000
1909	95	1,700	178,000
1910	104	1,800	222,000
1911	112	1,900	200,000
1912	122	2,100	260,000
1913	146	2,300	293,000

"But all this was in Russia in the past," goes on Mr. Sherville, a former Russian and associate of Mr. Popoff. "What has happened to the tea estates during the great war, it is impossible to say, but I was told by Mr. Popoff that trenches had been dug among the tea bushes and heavy guns posted in the gardens. In what state these gardens are now it is difficult to surmise."

Mr. Sherville's inquiry was answered in part by the late Mr. W. Keith Rollo, a well-known Ceylon tea planter, who served in the British Army in the World War. He wrote to the same newspaper: "The tea estates of Batoum province were entirely neglected and abandoned when I left South Russia in May 1919. They were first of all damaged by the Georgians after the Russian revolution, and they pinched everything they could lay hands on, and afterwards by the Turks, who drove the Georgians out of Batoum without, I believe, firing a shot . . . . As far as I know, no officer, while I was at G.H.Q., was sent to look after the tea estates of Batoum, although it was suggested on account of the grousing over the filthy German tea which was issued to the troops as rations. It was made, I believe, by the Germans from bay leaves and tasted like nothing on earth."

What really seems to have happened was that the warring forces of Turks, Mensheviks, British, and, finally, the Soviets surged across the Batoum district, making a battle ground of the tea area.

During the control of the Mensheviks, the cultivation dropped to 15 desiatins (1 desiatin = 27 acres).

THE POLITICAL DIVISIONS OF TRANS-CAUCASUS.

After the revolution, the pre-war Russian Trans-Caucasus was transformed (in 1920) into three Socialist Soviet Republics, namely, the Azerbaidjan S.S.R., the Armenian S.S.R., and the Georgian S.S.R. In 1922 these republics agreed to form the Trans-Caucasian Socialist Federal Soviet Republic, which has an area of about 200,000 sq. kilometers and a population of about 6,000,000 people. This is sub-divided, and the political and administrative structure of the Trans-Caucasian S.F.S.R., is divided into: (1) Georgia, consisting of the Georgian S.S.R., capital, Tiflis; Abkhasian S.S.R., capital Sukhum; South Ossetin Autonomous Area, capital, Pkhinvali; Adzharistan Autonomous Area, capital, Batoum; (2) Azerbaidjan, consisting of Azerbaidjan S.S.R., capital, Baku; and (3) Armenia, consisting of Nakhichevan Autonomous S.S.R., capital, Nakhichevan; Armenian S.S.R., capital, Erivan.

Thus it will be seen that the tea-growing area is situated in the Georgian S.S.R., and the Adzharistan Autonomous Area of the Georgian Republic of the Trans-Caucasian Socialist Federal Republic of the Union of Socialist Soviet Republics. Luckily for one's memory, it is usually referred to simply as Georgia or Trans-Caucasus.

WHAT THE SOVIET IS DOING.

Because the Russians are a race of tea drinkers, the Soviet Government has made and is now making serious attempts to develop the cultivation of tea in Georgia. It has been rather difficult, however, to get authoritative information as to how the plans are progressing. The work is in charge of the "Tcha-Guzy" or "Tea-Georgia," Ltd., with headquarters at Tiflis. Special credits have been granted to this organization, amounting in 1926 to four million gold roubles.

According to the latest (July 1928) reliable information, the area planted in tea in Georgia consists of 3,910 hectares, as against 1,912 hectares in 1927 and 1,341 hectares in 1926. The plans are to increase the area by not less than 20,000 hectares every five years. The cultivation is concentrated in the Batoum district of Adzharistan, the Ozourgetsky district of Georgia, and the Zougdidsky district of Mingrelia. According to Professor Krasnoff and Mr. Klingen's figures, there are about 70,000 acres suitable for tea planting.

The cultivation of the bushes consists in hoeing to a depth of 15 to 20 inches, weeding, and pruning. Plucking is begun when the plants are from four to five years old. The plucking is done by women and children. The majority of the estates yield up to 440 kilos per hectare. Each estate is plucked four times a year.

THE PRESENT TEA FACTORIES.

There are at present six factories under the control of "Tea-Geogia" Ltd. These are: Chakva, with an annual capacity of 1,700,000 lb.; Salisbaoury, 300,000 lb.; and Atzana, 125,000 lb. It is planned to erect twenty more factories in the next five years.

The factories are well built and are equipped with modern tea machinery made by Marshall Sons & Co., Ltd., Davidson & Co., Ltd., Henry Pooly & Son, Ltd., and Savage & Co. A new patent withering machine is being tried out.

Both black and green tea are manufactured. The finished product is packed in patent chests. The entire output is sold to the Centrosovus who blend it and pack it. They, in turn, sell it to the co-operative organizations through which it reaches the consumer.

It is claimed that the best quality of black tea made is equal to many kinds of China tea and to some of the medium and good common grades of low-country India teas. The leaf has an attractive appearance but the cup quality is said to be indifferent.

EXPERIMENTAL STATIONS.

At the present time, "Tea-Georgia," Ltd. has two tea experimental stations, one on the Chakva estate and one in the Ozourgetsky district. The work of the factories is based upon experiments made in these stations. Laboratory work now being carried on includes chemical analyses of the tea soils, investigations concerning the chemical factors affecting the quality of tea, etc. In the planted areas of the stations are plots of different jâts of tea, plots on which different kinds of pruning are tried out, plots for manuring experiments, etc.

The day when Georgian tea will make up any great part of Russia's consumption seems far off. It probably will never come. According to figures just given out by the Tea Brokers' Association of London and taken from official records, the imports of tea into the U.S.S.R., for the nine months ending June 30, 1928, were 32,233,600 lb. as against 24,062,080 lb. for the same period in 1926-27. By far the bulk of this came from China. The question is not "How much tea will Russia raise for herself ?" but "Where will she buy her supplies ?"

PRESERVING WOOD AGAINST DRY-ROT.*

WOODWORK is subject to damage by beetles, known as worm, and by fungi, inducing dry-rot. Bacteria are not known to participate even to a minor degree. When dry-rot has been discovered, the first step to be taken is to determine which of the many kinds is present, and then to take the most economical action to eradicate it and prevent its recrudescence. An informative report which covers the subject very comprehensively and gives some excellent photographs of typical damage caused by various dry-rot fungi has lately been published by the Department of Scientific and Industrial Research ("Dry-Rot in Wood," Forest Products Research, Bulletin No. 1, H. M. Stationery Office, 1s. 6d.). Treatment of dry-rot depends in each case on the conditions prevailing, and the precise kind of preservative to be used varies with the situation of the wood to be protected. Some wood preservatives are excluded from use, at least inside a house, by reason of their scent. Such is the case with creosote, and even with certain other less aromatic preservatives whose slight odour is still sufficient to taint fat (of bacon or butter), other food substances, and even cigars. Again some preservatives are excluded from use by reason of the colour they impart. Among the wood preservatives advocated as providing adequate protection against dry-rot in houses, some are good, some indifferent, and others worthless. Confidence should not be placed in the following: blue or green vitriols, common salt and lime water, which represent a series of decreasing fungicidal power. Copper sulphate in particular also attacks iron, and in its commercial form in presence of iron can vigorously attack wood. Zinc chloride, sodium fluoride and magnesium silicoflouride (acid) in proper concentrations are more useful, but when too strong the first-named itself attacks wood, while the much more fungicidal acid silicofluoride attacks iron and glass. Corrosive sublimate is highly poisonous, not only to the fungi in question but also to human beings, and has only slight powers of penetrating wood; yet under competent advice it may be used on occasion. It has one useful character, namely that it is soluble in alcohol as well as in water. Opposed to these inorganic preservatives are organic ones, among which carbolic, acetic and salicylic acids, as well as formalin, may be excluded from use on account of their early evanescence. Valuable preservatives for use in houses are some that are mixtures of tar-oils, especially coal-tar oils. Finally, in particular cases, mixtures of sodium fluoride and dinitrophenol or sodium dinitrophenate may be profitably used.

MAGNESIUM SILICOFLUORIDE.

In cases where the use of a tar-oil preservative is undesirable, either from the point of view of colour, odour, or danger of damage to surrounding work, a 5 per cent. solution of acid magnesium silicofluoride may be used, which is colourless and will not have any harmful effect. But the heavier tar-oil preservatives are recommended for the treatment of all timbers whenever suitable, as they are likely to remain effective for a longer period than the silicofluoride. The magnesium silicofluoride to be used is not the pure salt but the acid commercial salt, which is a white solid containing free acid. The solution is made by dissolving ½ lb. of acid

* From *The Chemist and Druggist* of February 2, 1929.

salt to one gallon of cold water. If desired it may be mixed with whitewash so long as it remains a 5 per cent. solution. It should be noted that this solution will attack metal and glass, and therefore should be mixed in a wooden tub; it has no adverse effect upon wood, brick, stone, mortar or plaster. The solution should be applied to the surface to be sterilised by means of a brush, and every effort should be made to ensure its penetration into all the cavities and cracks. Very often when decayed timbers are removed, bricks are found to be loose, and have to be taken out. They should be thoroughly cleaned of all dust and all mortar, and should be placed in a bucket of the silicofluoride, to soak for a short period, before being relaid.

TAR-OIL PRESERVATIVES.

The properties, and consequently the specification, appropriate to a preservative that is composed of tar-oils and is to be merely superficially washed or sprayed on the wood inside a house are different from those demanded by a preservative for use out-of-doors. The first property required by a preservative for outdoor use is that it shall be a powerful and durable preservative, but for indoor use an indispensable characteristic is that it shall not render a house or room uninhabitable by reason of its odour. It must therefore be free from naphthalene; evil-smelling sulphur compounds and thin oils containing a considerable percentage of the light-oils of lower boiling points are unsuitable because they adhere neither to the brush nor wood; moreover, they have a low ignition point so that, although the light-oils penetrate more rapidly, this advantage is lost because it is not safe or economic to heat the preservative to a temperature sufficiently high to aid materially the penetration into the wood; also the light-oils evaporate or change rapidly and their toxic efficiency is short-lived. One authority prescribes as a good preservative filtered anthracene oils 70 per cent., green oils (obtained from the distillation of pitch) 20 per cent., wood tar (devoid of water) 10 per cent. Others prescribe a mixture of tar-oils having a specific gravity of 1 :10-1 :12, distillation not beginning below 2308C. or boiling not beginning below 200°C. Another preservative found to be effective is a heavy tar-oil with volatile distillates of the character of heavy solvent naphtha. When 100 mil. of this are taken at 38°C, the distillation should conform to specific gravity at 60°F., 1·054; specific gravity at 100°F., 1·037; distillation up to 205°C., 1 per cent. by volume; distillation up to 230°C., 15 per cent. by volume; distillation up to 315°C., 50 per cent. by volume; distillation up to 380°C., 87 per cent. by volume; residue, non-volatile, at 315°C., 51 grams; tar acids, 7 per cent. by volume; tar bases, 1·9 per cent. by volume; naphthalene and other picrate forming hydrocarbons, 12·2 per cent. by volume; water, trace; matter, insoluble in benzene ("carbon"), 0·20 per cent. by weight. This specification contains a percentage of naphthalene, but the odour disappears after a short time, and this class of preservative is considered to be eminently suitable for indoor work. It is not practicable to lay down any one prescription as the right one; conditions vary and a considerable range of mixtures may be effected. The limits of variation within which oils, the products of coal-tar distillation (free of petroleum oils, but allowed to contain other toxic oils and salts) have been found in practice to be efficient out of doors when tested under the drastic conditions prevailing in the tropics, may be indicated as follows: (1) The specific gravity shall not be less than 1·015 and not more than 1·07 at 38°C; (2) the amount of tar acids shall be not less than 5 per cent. or more than 12 per cent. by volume; (3) the amount of water in the creosote shall not be more than 3 per cent.; (4) the amount of matter insoluble in benzol shall not exceed 0·4 per cent. by weight; (5) when 100 mil. measured at 38°C. of the dry

creosote are distilled from a 250 mil. Wurtz flask, with an outlet from the neck approximately 6 cm. from its base, and the distillation completed in about 20 minutes, there shall distil at 760 mm. pressure up to 205°C. from 0 to 7 per cent.; up to 230°C. from 10 to 40 per cent.; up to 315°C. from 45 to 78 per cent.; (6) the material shall be completely liquid on being slowly warmed to 38°C. with stirring, and on cooling down shall remain completely liquid after standing for two hours at 32°C. The heavier tar-oil preservatives have certain marked characteristics: (a) They usually possess a strong pungent smell, and when such a preservative is used on the interior woodwork of a building this smell may persist for weeks, or even months; (b) they are usually dark brown in colour, and therefore stain all woodwork; (c) it is not possible to apply oil paint over some preservatives of this type, as the preservative may "bleed" through and discolour, if not destroy, the paint; (d) oils possess considerable penetrative powers and will "creep" along the cracks or fissures of timber for considerable distances; (e) if the timber near a plaster ceiling or plastered wall be treated, the oils will creep into the plaster and cause discoloration (to prevent this, it is advisable to protect all adjoining surfaces with sheets of paper, or water-proofing cloth); (f) when these preservatives are used at moderately high temperatures, fumes are given off and sometimes cause a sense of discomfort in the eyes of the workmen; there is no permanent effect, however. Heavy tar-oil preservatives are highly inflammable, and whilst heating them every precaution should be taken against fire.

APPLICATION OF PRESERVATIVES.

The method of application of the preservative to wood (or other materials) varies with the degree of protection desired and the need for economy. The simplest and cheapest method is to apply one, or preferably two, coatings to the surface by means of either a brush or a spray. In order to ensure deeper penetration, suitable preservatives should be applied hot (for instance, those derived from heavy coal-tar oils at temperatures between 140° and 160°F.). Some of the silicofluorides, however, easily dissociate when heated and therefore must be applied cold. The weak points in mere superficial application of the preservative are that this penetration of the wood takes place only to a slight depth, with the consequence that, through cracks caused by skrinkage or by other means patches of wood not reached by the preservative are laid bare and the way is open for infection, while those preservatives soluble in water are liable to be washed out by rain, running or dripping water. When using preservatives on timber certain general measures are necessary in order to ensure as much penetration as possible: (1) Before treating old unattacked timbers which are to be retained, it is important that all dust and dirt should be removed; (2) timber to be treated with tar-oil preservatives should be in an air-dry condition; (3) in surface treatments two coats of the preservative should be applied, whenever possible, by means of a brush, and each coat should be thoroughly worked into the surafce fibres and cracks in the timber. Deeper penetration can be obtained by employing these preservatives in a heated condition at temperatures between 140°F. and 160°F. The penetration of the preservative into existing timbers is assisted by boring augerholes across the grain at convenient intervals; particularly, close to the ends from which any defective timber may have been removed. These holes should be filled with the preservative liquid and temporarily plugged. When the liquid has soaked away, the process should be repeated, and the holes permanently filled with wood plugs. This method is especially suitable for dealing with thick timbers, which cannot be removed, and which have had decayed portions cut from them. New timber and any old timber which can be easily removed for treatment should, if

practicable, be immersed horizontally in a bath of the preservative, maintained at a temperature of 140°F. to 160°F. for, say, at least 30 minutes.

PAINT.

The part played by paint on external woodwork is not quite simple. Properly brushed on to appropriately seasoned wood, it serves to hinder the ingress of water, prevents spores from reaching the bare wood, and decreases the liability of the wood to crack through shrinkage. But when the paint is applied to inadequately seasoned wood, it may do more harm than good; for the paint blisters, patches of wood are soon laid bare, and the wood may split as it dries and shrinks. The result is that spores, alighting on bare patches or falling into damp cracks, may germinate and find available to them wood which has been kept relatively moist by the coating of paint, so that decay may be more rapid than if the wood had not been painted.

[Note.—It should be noted that, as far as Ceylon is concerned, much more damage to woodwork is done by termites than by dry-rot of fungus origin.]

MEETINGS, CONFERENCES, ETC.

COCONUT RESEARCH SCHEME BOARD OF MANAGEMENT.

Minutes of the first meeting of the Board held at 2 p.m. on Wednesday, April 17, 1929, in the ante-room of the Legislative Council Chamber, Colombo.

The following were present: Dr. W. Small, Acting Director of Agriculture and Acting Chairman of the Board, Mr. C. E. Jones, C.C.S., Hon. Mr. C. H. Z. Fernando, Hon. Mr. A. Mahadeva, Hon. Sir H. Marcus Fernando, Gate-Mudaliyar A. E. Rajapakse, Mr. J. Sheridan-Patterson, Mr. J. Fergusson and Mr. John Perera. Apologies for absence were received from the Hon'ble Mr. D. S. Senanayake and Mr. H. R. Outschoorn.

(1) *Meetings of the Board.*—It was pointed out that the Board was required by the Coconut Research Ordinance to meet quarterly and it was agreed to leave the question of calling more frequent meetings when necessary in the hands of the Acting Chairman. It was also agreed that in the meantime the Board should hold its meetings in Colombo on the first Wednesday of the month at 2-30 p.m.

(2) *Clerical work of the Board.*—The Acting Chairman was authorised to make temporary arrangements for the clerical and accounting work of the Board; overtime at the rate of Re. 1/- per hour to a clerk or clerks of the Department of Agriculture was sanctioned.

(3) *Travelling expenses of members of the Board.*—On the proposal of Sir Marcus Fernando, seconded by Gate-Mudaliyar Rajepakse, it was decided that members of the Board should be entitled to claim travelling expenses at the rate of 55 cents per mile from their places of residence to the nearest railway station and back and first class return rail fare to Colombo.

(4) *Minutes of the Board.*—It was agreed that the minutes of the Board should be published in the local press and *The Tropical Agriculturist* after circulation among, and approval by, the members of the Board.

(5) *Finance.*—The Acting Chairman detailed the financial position of the Board and reported that to date the sum of Rs. 13,367 :78 had been collected as cess on exported coconut products. The Board agreed that this sum or a portion of it should be obtained from the Colonial Treasurer in whose hands it had been placed and should be deposited in the National Bank of India, Ltd. The question of the branch of the bank in which an account should be opened in the name of the Scheme was left in the hands of the Acting Chairman, and the Acting Chairman was authorised to sign the cheques of the Scheme.

(6) *Estate.*—After discussion in which the members present took part, it was decided that the Acting Chairman should draw up an advertisement for an estate and should circulate it among members of the Board for approval. It was agreed that the estate should be situated in the North-Western Province, should be on or near a motor road and should consist of 200 acres of coconuts, of which at least one-third should be in bearing and of 100 acres of jungle capable of cultivation. The following sub-committee was elected to deal in due course with offers of land: the Acting Chairman, Hon. Mr. D. S. Senanayake, Gate-Mudaliyar A. E. Rajapakse, Hon. Mr. C. H. Z. Fernando and Mr. J. Fergusson.

(7). *Research staff and lines of work.*—The lines of work suggested by the Acting Chairman were agreed to, and it was decided to bear in mind and to bring up at a later date the suggestion of the Hon. Mr. A. Mahadeva that the Board should include in its scope of work the investigation of the business principles which make for the return of the greatest profit from a coconut estate as a whole, e.g., the relation between capital and profits, size of an estate and profits, size of an estate in relation to efficiency in the use of labour, size of an estate and efficiency in the use of machinery, crop yields in relation to profits, etc. After discussion it was agreed that the Scheme should employ the services of a director of its research work who should be called Director of the Coconut Research Scheme and who should also be in charge of soil investigation and field experimentation. The Acting Chairman was empowered to take steps to advertise the post of Director and to obtain the help of Dr. A. W. Hill, Sir John Russell, Sir John Farmer and Mr. F. A. Stockdale in the selection of a man for the post after the usual advertisement. It was decided that the salary of the Director should be £1,200—50—£1,350. The Acting Chairman reported that he had enquired from the Planters' Association of Ceylon whether the staff of the Coconut Research Scheme would be allowed to join the Planters' Association Provident Fund, but had not received a reply. The Board was of opinion that it was desirable that its officers should belong to a Provident Fund. It was agreed that the question of proceeding to appoint a Technological Chemist and a Geneticist should be taken up later.

W. SMALL,
Acting Chairman,
Board of Management,
Coconut Research Scheme.

13th May, 1929.

CEYLON TEA RESEARCH INSTITUTE.

MINUTES of a meeting of the Board of the Tea Research Institute of Ceylon, held in the Ceylon Chamber of Commerce, Colombo, on Tuesday the 9th April, 1929, at 2-15 p.m. Present:—Mr. R. G. Coombe (Chairman), the Hon'ble the Colonial Treasurer (Mr. W. W. Woods), the Acting Director of Agriculture (Dr. W. Small), the Hon'ble Mr. J. W. Oldfield, the Hon'ble Mr. D. S. Senanayake, Messrs. E. C. Villiers, W. Coombe, J. D. Finch Noyes, P. A. Keiller, John Horsfall, D. S. Cameron and A. W. L. Turner (Secretary) and by invitation Dr. C. H. Gadd and Mr. J. W. Ferguson.

Before proceeding with the business of the day a vote of condolence was passed with the relatives of the late Dr. C. A. Hewavitarne who was killed in a motor accident on the 3rd April.

FINANCE.

(a) The statement of accounts as at 31st March, 1929, was tabled.

(b) It was decided to place Rs. 200,000 on Fixed Deposit for six months.

(c) *St. Coombs Estate Estimate and Accounts.*—A copy of the estimate for 1929 was tabled. It was decided that in future each member of the Board should receive a copy of the estimate and the monthly accounts.

ANNUAL REPORT, 1928.

The annual report for 1928 was adopted.

TEA RESEARCH CONFERENCE, 1929.

On the suggestion of the Chairman the Board expressed its appreciation of the papers read by the members of the Scientific Staff and others at the first conference organized by the Institute, which was held in the board room of the Department of Agriculture on March 11th, 1929.

A vote of thanks to the Acting Director of Agriculture for the loan of the board room was also passed.

It was also decided that the report of the Conference should be published in the Institute's journal, the *Tea Quarterly.*

BUNGALOWS.

(a) *Superintendent's Bungalow.*—The Chairman announced that Mr. S. D. Meadows' plan and estimate had been accepted, and the work commenced after reference to each member of the Board by post. The bungalow is to cost Rs. 41,330.

The acceptance of this was confirmed.

(b) *Senior and junior Scientific Staff Bungalows.*—The Chairman stated that the position was clearly explained in the minutes of the meeting of the Estate Sub-Committee held in Nuwara Eliya on March 23rd.

After a general discussion it was proposed by the Hon. the Colonial Treasurer, seconded by Mr. J. D. Finch Noyes, that the recommendations made by the Estate Sub-Committee should be adopted, and it was unanimously decided that Mr. S. D. Meadows' plan No. 291, dated the 18th February, 1929, and the specification sent therewith, should be adopted for the Director's bungalow and the senior staff bungalows costing Rs. 41,330 each, inclusive of sand and architect's fees.

It was also unanimously decided to adopt Mr. S. D. Meadows' plan No. 290, dated the 18th February, 1928, and the specification sent therewith for the bungalows of the junior scientific staff provided the cost of each bungalow did not exceed Rs. 8,500 inclusive of sand and architect's fees.

Mr. W. Coombe, seconded by Mr. John Horsfall, proposed that tenders for the erection of the bungalows should be advertised for in the Press.

This was agreed to.

LABORATORIES.

The Chairman stated that full particulars of Messrs. Adams and Small's plan and specification would be found in the minutes of the Estate Sub-Committee meeting held on the 24th March, and that the Sub-Committee had unanimously recommended the adoption of these plans and estimates, subject to a few minor conditions.

On the proposal of Mr. W. Coombe, seconded by the Hon. Mr. Senanayake, it was decided to adop the Sub-Committee's recommendations.

Mr. P. A. Keiller suggested that a vote of thanks be accorded to Messrs. Adams and Small for the very great trouble they had taken in meeting the Institute's wishes. This was agreed to.

LEASE OF "LINDFIELD."

The Chairman announced that Col. T. G. Jayewardene, V.D., had agreed to renew the lease of "Lindfield" for a further period of six months, as from 1st July 1929.

MAHAGALLA BUNGALOW.

The Chairman stated that he had sanctioned the renewal of the rental of this bungalow till the end of 1929 with the option of renewal for a further period of six months, at the present rent of Rs. 125 per mensem.

The Chairman's action was confirmed.

MORTGAGE ON ST. COOMBS ESTATE.

The seal of the Institute was duly affixed to the mortgage bond on St. Coombs Estate. This makes the estate a first charge against the sum Rs. 1,000,000 borrowed from the Ceylon Government.

Cooly Lines.—The Chiarman stated that, as there was a shortage of accommodation for the various workmen who had to be housed, he had authorised the erection of ten more rooms.

The Chairman's action was confirmed.

VISITING AGENT'S INSPECTION REPORT.

This was tabled and it was decided that a copy should be sent to each member of the Board.

With regard to the report, Mr. J. W. Ferguson said that it was most essential that all building sites and roads should be pegged out and he suggested that the Experimental Sub-Committee should meet and decide on a policy.

This was agreed to and it was further decided that the Architect should proceed to St. Coombs as soon as possible and meet the Visiting Agent and the Superintendent and peg out the sites of all roads and buildings, including gardens. The meeting was of the opinion that this visit should be made not later than the 19th April.

STAFF OF THE TEA RESEARCH INSTITUTE.

The Chairman announced that the Selection Board in England strongly recommended the appointment of Professor R. V. Norris, D.Sc., F.I.C., Professor of Bio-Chemistry, Indian Institute of Science, to the post of Director of the Institute.

It was decided to accept the recommendations of the Selection Board and to appoint Professor Norris.

The Chairman stated that the Selection Board strongly recommended Professor W. H. Brittain, of Macdonald College, Quebec, as Entomologist, if suitable terms could be arranged.

It was decided that discussion on the post of Plant Physiologist be postponed.

The Chairman promised to make enquiries when at Home.

The Chairman asked the Board to accord a very hearty vote of thanks to Dr. A. W. Hill and the other members of the Selection Board for the trouble they had taken.

THE ACTING DIRECTOR—DR. C. H. GADD.

This officer was granted permission to proceed on nine months' leave as from the 8th May, 1929. It was also decided that Mr. M. T. Eden should act for the Director from that date until the arrival of the new Director.

BIO-CHEMIST—DR. D. I. EVANS.

The Chairman reported that this Officer had returned from 12 weeks' leave out of the Island.

ASSISTANT TO THE CHEMISTS.

The Chairman announced that Mr. E. N. Perera had reported for duty on the 15th February, 1929.

COMMITTEE FOR AGRICULTURAL EXPERIMENTS.

It was decided to adopt the Acting Director's suggestion as set forth in his letter No. 140 dated the 23rd January, 1929, which had been sent to the members of the Board.

The following were appointed to serve on the Committee:—

The Director of the Institute, the Agricultural Chemist, the Visiting Agent of St. Coombs, the Superintendent of St. Coombs, Messrs. John Horsfall and C. C. Du Pre Moore.

It was further decided that this Committee should make arrangements with regard to experimental plots and work without reference to the Board and should have power to co-opt any member of the Scientific Staff and that the Agricultural Chemist should be Secretary and convener of the Committee.

TEA SEED FOR EXPERIMENTS.

It was decided that this matter should be dealt with by the Experimental Committee.

NETTLE GRUB IN UVA.

The Chairman said that the Chairman of the Uva District Planters' Association had suggested that the Board should detail an Assistant with some entomological knowledge to work independently of the Assistant sent to Uva from the Department of Agriculture, but both Assistants should be under the control of Mr. Hutson of the Department of Agriculture.

On the suggestion of the Acting Director of the Institute it was decided to leave this matter over until the arrival of the new Entomologist.

QUARTERLY REPORTS.

It was decided that the Director's Quarterly Review should be published regularly in the *Tea Quarterly*.

BOARD OFFICIALS.

The appointment of Messrs. E. C. Villiers and P. A. Keiller to the Estate Sub-Committee was confirmed.

The Chairman announced that Mr. H. F. Parfitt having resigned the chairmanship of the Ceylon Estates Proprietary Association automatically resigned his seat on the Board. He had been succeeded in the chair of the Ceylon Estates Proprietary Association by Mr. W. Coombe who therefore succeeded Mr. Parfitt on the Board.

Messrs. R. G. Coombe and John Horsfall were granted leave of absence and it was announced that Mr. C. Huntley Wilkinson and Mr. C. C. Du Pre Moore had been nominated by the Planters' Association to act on the Board during their absence.

SECOND IMPERIAL MYCOLOGICAL CONFERENCE.

It was decided that Dr. C. H. Gadd should attend this conference.

EMPIRE MARKETING BOARD.

It was decided that Mr. R. G. Coombe and Mr. John Horsfall should make enquiries when at Home with a view to ascertaining if the Empire Marketing Board could allocate any of the funds at their disposal for the purpose of furthering Tea research work in Ceylon.

THE CHAIR.

The Chairman announced that the Hon. Mr. J. W. Oldfield had consented to act as Chairman during his (Mr. Coombe's) absence on leave. This met with the unanimous approval of the Board.

The Hon. Mr. J. W. Oldfield then called upon the Board to pass a very hearty vote of thanks to Mr. R. G. Coombe for all the hard work he had put in.

This was accorded with applause and, Mr. R. G. Coombe having replied, the business of the meeting terminated.

A. W. L. TURNER,
Secretary,
Tea Research Institute of Ceylon.

DEPARTMENTAL NOTES.

REPORT ON THE SECOND ANNUAL AGRICULTURAL AND INDUSTRIAL SHOW, ALUBOMULLA.

THIS show, which is under the auspices of the three Co-operative Societies of Alubomulla, Pamunugama and Imbliha, Mahabellana and Urakaduwa, was held on March 9, 1929, at the Alubomulla Boys' School. The assistant Government Agent, Kalutara, opened the show. There was an increase of 324 exhibits over the former show.

The Divisional Agricultural Officer, Southern Division, was in attendance and the Plant Pest Inspector of the Southern Division had an exhibit of local pests and diseases under the charge of a Sub-Inspector while the Agricultural Instructor of Bandaragama acted as a judge and assisted in arranging the exhibits.

The show was organised on similar lines to the previous one and great credit is due to Mr. A. M. Clement Dias and the working committee. The show was well attended and it was the opinion of all that it was a great success. The total number of exhibits was 693. A total of 118 cwt. of artificial manure had been sold to the cultivators of the show area during the season for application to their plots of produce for the show.

The vegetable section was the most prominent. There was a noticeable improvement on last year's exhibits, especially in the varieties and specimens of snake gourd, bitter gourd, cucumber, brinjals and bandakka. Other exhibits included chillies, luffa, spinach plants, radish, yams and a large variety of pot herbs. Some new and good imported varieties were to be seen, seed of which was obtained and distributed by Mr. A. M. Clement Dias. In the fruit section an appreciable improvement in pineapple and papaw fruits was noticed. The exhibits on the whole were fair; citrus fruits were poor. The exhibits in paddy were only fair though considerably in advance of last year's.

The section for economic products consisted of samples of milk, dried jak in considerable quantity, arecanut and betel leaves, bunches of coconuts and village rubber of very fair quality. An interesting and instructive exhibit of fodder in the form of locally grown Napier grass was arranged by Mr. A. M. Clement Dias and the methods of cultivation were indicated.

In the industrial section there were some creditable exhibits of chairs, mats, pottery, slippers made of bandakka fibre, and of drawings and painting from local schools which also had an exhibit of home garden produce.

PADDY CULTIVATION COMPETITION IN MATALE SOUTH.

A paddy cultivation competition was held in Matale South during the maha season 1928-29.

The entries were fewer than last year because of the difficulty of obtaining buffaloes as a result of an outbreak of hoof-and-mouth disease in the district. Forty-two cultivators transplanted their fields, while the rest applied green and farmyard manures.

Assistance was rendered to the cultivators by the Agricultural Instructor of the division who visited the fields and gave necessary advice and also carried out preliminary judging.

Final judging of the fields was done by Mr. F. D. Peiris and the Agricultural Instructor, when the following were adjudged winners and granted departmental certificates :—

1. S. M. B. Amunugama of Aluvihare.
2. Megastennegedera Kiri Banda of Dombewela.

PADDY CULTIVATION COMPETITION IN MATALE EAST.

A paddy cultivation competition was held for Pallasiya Pattu and Ambaranganga Korales in Matale East during maha season of 1928-29.

Forty cultivators entered the competition, an increase of three over last year. Seventeen cultivators had transplanted, while the rest had applied green manure and farmyard manure.

Assistance was rendered to the cultivators by the Agricultural Instructor of the division who visited the fields and gave all necessary advice and carried out the preliminary judging.

The final judging of the fields was done by Mr. F. D. Peiris, in conjunction with the Agricultural Instructor, when the following were adjudged winners and granted departmental certificates :—

1. Patabendittandirigedera Muhandirama of Gurubebila.
2. Pallamae Henayalaigedera Kiri Henaya of Gurubebila.

PURE LINE PADDY CULTIVATION COMPETITION IN YATINUWARA AND HARISPATTU.

Paddy cultivation competition for Yatinuwara and Harispattu areas was held during the maha season of 1928-29, when fifty-six cultivators entered.

Assistance was rendered to the cultivators by the Agricultural Instructor of the division and the Divisional Agricultural Officer who inspected the fields on several occasions and gave advice.

There was a marked increase in the yield over last year, some of the fields yielding 70 bushels per acre.

The final judging was done during March-April, when the following were adjudged prize winners :—

YATINUWARA.

1.	T. B. Mampitiya of Ranawana	... ...	Rs. 45·00
2.	P. B. Halangoda of Kobbekaduwa	... ...	,, 20·00
3.	Viharagedera Banda of Kiribathkumbura	...	,, 15·00
4.	Harama Panikkaya of Katugastota	...	,, 7·50

HARISPATTU.

1.	H. L. de Silva of Gohagoda	... ...	Rs. 45·00
2.	C. Dunuwile of Kendedeniya	... ...	,, 20·00
3.	Ukkuwa of Kendedeniya	... ...	,, 15·00
4.	Galadde of Attaragama	... ...	,, 7·50

Departmental certificates have also been awarded to the successful competitors.

BOOK REVIEWS.

PLANT DISEASES.

THE number of books covering the whole field of plant pathology is limited while the value of a carefully written treatise is great. It is therefore pleasing to note the publication of "Plant Diseases,,* especially as it originates from the pen of Mr. F. T. Brooks of Cambridge. Although the book deals mainly with diseases of plants in the British Isles, a number of tropical diseases is considered and the fact that the author was Mycologist in the Federated Malay States in 1914 renders his book of more than usual interest to workers in the tropics. The scope of the work is aptly summarised in the preface where it is stated that

> "The author has had a good deal of experience in training men to serve as plant pathologists at home and abroad, and his book is designed particularly to assist such students and others who are carrying out investigations on plant diseases. It is hoped that the book will be useful to the general botanist, to students of agriculture, horticulture and forestry, and to cultivators of the soil who take an enlightened interest in the crops they grow."

The introductory chapter gives a clear and concise account of the principles of plant pathology, written in a manner which will enable the layman to grasp the fundamentals of the subjects. This is followed by chapters on non-parasitic and virus diseases. Brown bast, a disease of local interest, is mentioned in the former of these and it is to be regretted that the author has not mentioned the Keuchenius method of treatment which recently has proved to be of value. A short account is given of the fungi and their classification which is followed by the main subject-matter in which diseases are arranged according to the pathogen and not the host plant. This arrangement gives the book a pleasing continuity and the use of the common names for the various diseases recommended by the Plant Pathology Sub-Committee of the British Mycological Society,† combined with an efficient index, obviates any difficulty likely to be experienced in reference by the non-scientific reader.

A brief description of the causal organism is given under each heading, together with notes on the symptoms and control of the disease. Full bibliographical references are given at the end of each chapter and these will enable the worker and student to extend his study of any one particular disease when necessary. The concluding chapter refers to fungicides and, in addition to giving information on the general principles of their application, gives useful notes on their preparation.

All the illustrations are new, and the volume is well up to the high standard maintained by the publishers.

In conclusion, the words of the preface quoted above may be reiterated and a careful perusal of the book be recommended to those planters "who take an enlightened interest in the crops they grow."—M.P.

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* "Plant Diseases" by F. T. Brooks, M.A., F.L.S., viii+386 pp. 62 figs., Oxford Univ. Press, 1928. 21s.

† List of common names of British plant diseases. Trans. Brit. Myc. Soc. vol. 14, pts. 1 and 2, p. 143, March 1929.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MAY, 1929.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st 1929	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	1789	333	280	1353	24	132
	Foot-and-mouth disease	28	38	33	.	5	..
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	2	...	1	1	..	...
	Rabies*. (Dogs)						
Colombo Municipality	Rinderpest	1363	82	119	1205	39	...
	Foot-and-mouth disease	219	160	204	12	3	...
	Anthrax	...	..	...	...	..	...
	Rabies (Dogs)	12	...	...	...	...	12
Cattle Quarantine Station	Rinderpest	44	...	27	17	...	..
	Foot-and-mouth disease	40	7	40	...	..	...
	Anthrax	...	...	...	...	...	...
Central	Rinderpest	46	..	1	44	...	1
	Foot-and-mouth disease	837	74	797	2	38	...
	Anthrax	...	...	...	...	...	...
	Haemorrhagic Septicaemia	3	3	...	3	...	...
	Rabies (Dogs)	12	3	...	...	...	12
Southern	Rinderpest	...	.	...	...	...	...
	Foot-and-mouth disease	2013	...	1957	56	...	...
	Anthrax	...	...	...	...	...	...
Northern	Rinderpest	4	...	3	...	...	1
	Foot-and-mouth disease	157	...	87	70	...	...
	Anthrax	...	...	..	...	...	...
Eastern	Rinderpest	...	..	...	...	...	...
	Foot-and-mouth disease	8006	..	7851	155	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Horses)						
North-Western	Rinderpest	345	131	47	208	13	77
	Foot-and-mouth disease	...	...	...	...	...	..
	Anthrax	...	...	...	..	...	...
	Piroplasmosis	5	4	1	...	4	...
North-Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	26	...	26	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	319	15	302	1	15	1
	Anthrax	...	...	...	...	...	...
	Haemorrhagic Septicaemia	1	...	...	1	...	...
Sabaragamuwa	Rinderpest	240	47	32	203	5	...
	Foot-and-mouth disease	4492	41	4294	115	83	...
	Anthrax	...	...	...	...	...	...
	Haemorrhagic Septicaemia	14	...	1	13	...	...

G. V. S. Office,
Colombo, 10th June, 1929.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL

MAY, 1929.

Station	Temperature		Mean Humidity	Mean amount of Cloud (0=clear 10=overcast)	Mean Wind Direction During Month	Daily Mean Velocity	Rainfall		
	Mean Daily Shade	Difference from Average					Amount	No. of Rainy Days	Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	82·2	+0·2	81	8·5	SW	140	15·46	23	+ 1·90
Puttalam	83·2	+0·5	82	6·6	SW	168	3·69	8	+ 0·24
Mannar	85·6	+0·2	78	8·2	SSW	234	1·50	5	— 0·52
Jaffna	84·2	—0·3	84	5·4	SW	361	0·71	3	— 0·98
Trincomalee	84·6	0·4	75	5·6	WSW	185	3·19	6	+ 0·74
Batticaloa	83·6	—1·0	78	4·6	Var.	128	0·38	4	— 1·37
Hambantota	82·2	0	82	5·4	SW	340	1·14	10	— 2·06
Galle	81·8	0	83	6·8	W	210	4·69	20	— 6·80
Ratnapura	81·6	—0·2	81	6·4	—	—	14·96	25	— 3·29
Anu'pura	83·0	—0·5	82	6·8	—	—	2·87	6	— 0·48
Kurunegala	82·8	0	76	8·4	—	—	4·04	15	— 2·55
Kandy	78·9	+0·2	78	6·4	—	—	2·44	13	— 3·31
Badulla	75·7	+0·3	82	6·0	—	—	9·72	12	+ 5·16
Diyatalawa	70·2	+0·4	80	6·8	—	—	5·03	15	— 0·14
Hakgala	65·7	+0·5	84	5·2	—	—	6·75	13	— 0·27
N.Eliya	62·0	+0·2	82	6·5	—	—	7.43	18	+ 0·61

The rainfall during May has been below normal on the south-west slopes of the hill-country, in the south of the island, in the extreme north, and in the coastal districts near Batticaloa. It has been generally above normal in Colombo and the adjacent districts, on the leeward slopes of the hills, and over the greater part of the North-Central and North-Western Provinces.

There were 20 daily falls of over 5 inches recorded during the month, mainly in the low-country districts adjacent to Colombo, and on the 22nd-23rd, though several were also recorded on the 24th-25th. The highest falls recorded were 15·56 at Rayigam, 11·09 at Halwatura, 10·76 at Marambekanda, and 10·69 at Gendagala, all on the 22nd-23rd.

Mean temperatures for the month show no great deviations from normal. The mean humidity has been in the neighbourhood of 80%. Cloud and wind-strength have both been generally a little above normal, and wind directions mainly south-westerly.

Heavy wind squalls occurred on the 11th, accompanied by rain. This storm caused the loss of several lives among fishermen on the south-west coast.

H. JAMESON,
Actg. Supdt., Observatory.

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